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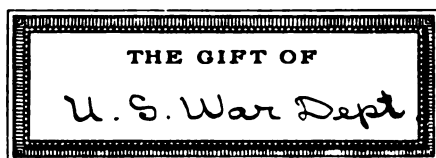
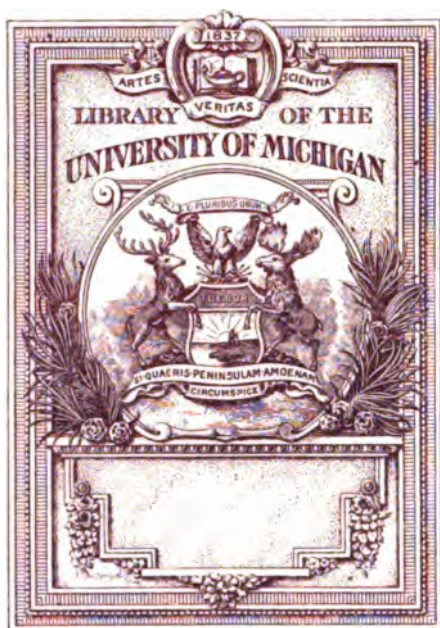
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ANNUAL REPORTS

OF THE

WAR DEPARTMENT

FOR THE

FISCAL YEAR ENDED JUNE 30, 1905.

VOLUME IX.

REPORT OF THE CHIEF OF ORDNANCE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

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GOVERNMENT PRINTING OFFICE
1905.**

REPORT OF THE CHIEF OF ORDNANCE.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, November 2, 1905.

SIR: I have the honor to submit the following report of the principal operations of the Ordnance Department during the past year, together with certain remarks as to its interests and necessities. During my absence in Europe, from August 18 to October 16, to attend the autumn maneuvers of the French army, Lieut. Col. A. H. Russell acted as Chief of Ordnance and conducted the affairs of the Department to my entire satisfaction.

PERSONNEL.

The difficulties of the Department in regard to the personnel of its officers have been set forth in previous reports and other communications with all the force that it is known how to give to them. The disadvantages still continue with the increase due to an accumulation of matters which should have been attended to but have not been. The strain has begun to tell upon the officers; 8 of these, out of the Department's 59 (all that it has been able to secure of its authorized strength of 71), have been seriously ill during the past year. One has broken down and has had to be permanently relieved from his exacting duties and assigned to an easier place; 2 have had sick leaves, and 2 have been sick for a considerable time at their stations. In the following portions of this report various instances are cited in which important work which has been pressing for accomplishment has had to be neglected. The Department is now 12 short of its authorized number, which number is itself too small. By the operation of the present law 2 of its officers, who will have been serving in the Department for four years, will within a few months leave it through the expiration of their details. If they were to be out of the Department for one year only, arrangements could be made looking to the later utilization of their services and of their acquired knowledge and experience, both having become valuable technical officers, and their service for one year in their former branches would be beneficial both to them and to this Department and to the Army

REPORT OF THE CHIEF OF ORDNANCE.

Appropriations.	Receipts, etc.						Total.
	Amount in the Treasury to credit of ordnance ap- propriations on July 1, 1904.	Amount deposited in the Treasury on account of the Ordnance Department, but not credited to ordnance appropriations on July 1, 1904.	Amount in United States depositories to credit of disbursing officers under ordnance appro- priations on July 1, 1904.	Amount of appropriations made for the fiscal year ended June 30, 1905, including the amount of those contained in the act making appropria- tions for fortifications and other works of de- fense, etc., approved March 8, 1905, under con- trol of the Ordnance Department.	Amount refunded during the fiscal year ended June 30, 1905, to ordnance appropriations by Treasury settlements, on account of transfers of property to the various bureaus and Execu- tive Department, to the organized militia, etc.	Amount received during the fiscal year ended June 30, 1905, from sales of ordnance and ordnance stores; from collections from troops on account of loss or damage to ordnance stores; from Chicago, Rock Island and Pacific R. R. Co. on account of maintenance of Rock Island bridge; proceeds arising from tests made by the Govern- ment testing machine at Watertown Arsenal, and from other sources not before mentioned.	
Ordnance service, 1905.				\$200,000.00	\$512.88	\$1.50	\$200,512.88
Ordnance stores—ammunition, 1905.				1,150,200.00			1,150,200.00
Ordnance stores and supplies, 1905.				1,625,000.00			1,625,000.00
Replacing ordnance and ordnance stores, 1904-5.	\$190,965.72	\$7,700.83	\$287.54		471,546.53	323.90	770,794.51
Replacing ordnance and ordnance stores, 1905-6.					610,854.06	101,671.26	712,525.32
Manufacture of arms, 1904-5.		.25			9,976.91	13.40	2,852,703.72
Manufacture of arms, 1905-6.	2,163,632.96		350,073.23	1,700,000.00	860.46		1,700,860.45
Artillery targets, 1905.				41,600.00			41,600.00
Ammunition for morning and evening gun, 1905.				12,500.00			12,500.00
Replacing ordnance and ordnance stores destroyed by fire at Rock Island Arsenal, Ill., 1903-4.	12,278.20			75,000.00		13.20	44,612.88
Ordnance material (proceeds of sales).			28,824.18				119,864.66
Field artillery for organized militia, 1904-5.	585,000.00		43,671.82				585,000.00
New arms and equipments for organized militia.	477,613.35		50,961.50			.12	527,705.20
Converting muzzle loading guns for snailting purposes, 1905.				40,000.00			40,000.00
National trophy and medals for rifle contests, 1905.				2,600.00			2,600.00
Medals of honor for distinguished services.				12,000.00			12,000.00
Repairs of arsenals, 1905.				125,000.00			125,000.00

Board of Ordnance and Fortification	408,647.88	2,932.52	14,298.14	10,000.00	1,488.63	70.40	434,379.10
Armament of fortifications	8,620,285.05		861,325.59	2,988,550.00	28,959.90		12,022,142.46
Fortifications in insular possessions	418,920.00			238,000.00			82,000.00
Encampment and maneuvers, organized militia, 1905				32,000.00			82,000.00
Proving Ground, Sandy Hook, N. J.	223,886.00		22,292.88	115,943.00			961,611.88
Frankford Arsenal, Philadelphia, Pa.	71,588.92		18,376.61	52,500.00			124,445.95
Powder Depot, Dover, N. J.	55,985.43		2,941.27	104,400.00			178,762.04
Rock Island Arsenal, Rock Island, Ill.	49,500.00		2,317.52	83,500.00			85,941.27
Rock Island Arsenal, Rock Island, Ill., 1903-4	128,000.00						130,317.59
Rock Island Bridge, 1905							16,861.80
Rock Island Armory, Ill.							92,242.88
Springfield Arsenal, Springfield, Mass.	7,100.00		17,242.88	12,500.00			92,242.88
Benicia Arsenal, Benicia, Cal.	32,500.00		2,055.36	11,500.00			18,555.36
Watertown Arsenal, Watertown, Mass.		316.06	4,396.06	6,000.00			7,419.70
Testing machine, 1905							1,107.19
San Antonio Arsenal, San Antonio, Tex.	16,000.00		13,064.87	18,000.00			16,107.19
Waterfront Arsenal, West Troy, N. Y.	71,770.00			16,000.00			102,834.87
Manila Ordnance Depot, Manila, P. I.							16,000.00
Enemy landing apparatus	10,000.00						10,000.00
Island shell and "tuttle" thorite "	100,000.00		7,520.11				77,274.88
Torpedoes for harbor defense	100,000.00						100,000.00
Submarine mines	1,556.74			300,000.00	5.80		400,056.80
Ordnance stores—ammunition, 1903	75,567.21						1,556.74
Ordnance stores—ammunition, 1904	6,266.74						75,567.21
Ordnance stores—equipment, etc., 1903	16,008.59						6,266.74
Ordnance stores—preservation, 1903							16,008.59
Ordnance stores—repairs, 1903	2,255.51						601.17
Artillery targets, 1903	60.91						2,255.51
Ammunition for morning and evening gun, 1903	249.49						60.91
Ordnance service, 1904	882.76	72.80	24,584.99			2.82	249.49
Ordnance stores—ammunition, 1904	62,711.59	49.52	123,794.71			1.37	25,643.06
Ordnance stores—equipment, etc., 1904	3,253.61		100,861.55		10.00	1.94	196,547.19
Ordnance stores—preservation, 1904	74,488.07		199,792.49				103,947.10
Ordnance stores—repairs, 1904	203.82		5,558.57				274,200.49
Repairs of arsenals, 1904	580.82	22.32	13,572.83		87.75		5,762.39
Artillery targets, 1904	15,562.60	600.00	21,082.06				14,213.82
Ammunition for morning and evening gun, 1904			20,581.18				87,295.05
Manufacture of arms, 1904-5	10,204.34		445.22				21,167.86
National trophy and prizes for Army and militia, 1904			100,863.01				10,649.56
Testing machine, 1904	43.00		2,005.56				100,863.01
Field artillery for organized militia, 1905-6				516,000.00			2,005.56
Rock Island Bridge (War)	2,500.00						516,000.00
National Defense (War)	90,841.94		1,180.64				2,500.00
Ordnance stores—equipment, certified claims					1,441.92		90,841.94
Ordnance stores—equipment, 1902 and prior years				50.00			2,822.56
Miscellaneous receipts					187.91		50.00
Sales of ordnance material						423.68	187.91
						172,473.61	423.68
Total	14,177,872.73	11,694.49	1,585,583.72	9,687,708.00	1,125,227.68	279,905.60	26,807,493.31

REPORT OF THE CHIEF OF ORDNANCE.

Statement showing the expenditures, etc., of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1906.

Appropriations.	Expenditures, etc.							Total.
	Amount disbursed by disbursing officers from Ordnance appropriations during the fiscal year ended June 30, 1906.	Amount paid and transferred by Treasury settlements during the fiscal year ended June 30, 1906, from Ordnance appropriations on account of transfers and property from other bureaus and Executive Departments to the Ordnance Department, and of payment to contractors for certain purchases, etc.	Amount deposited in the Treasury during the fiscal year ended June 30, 1906, and credited to "Ordnance material (proceeds of sales)."	Amount covered into the Treasury under "Miscellaneous receipts" on account of proceeds of Government property during the fiscal year ended June 30, 1906.	Amount covered into the "Surplus fund" of the Treasury on June 30, 1906.	Amount in United States depositories to credit of disbursing officers under Ordnance appropriations on June 30, 1906.	Amount deposited in the Treasury on account of Ordnance Department appropriations, on June 30, 1906.	
Ordnance service, 1905.....	\$246,309.10	\$4,870.95				\$44,890.05	\$771.70	\$300,819.83
Ordnance stores - ammunition, 1905.....	785,357.44					136,073.26	2,472.03	1,163,886.00
Ordnance stores and supplies, 1905.....	1,439,731.42	121.00				136,493.03	1,881.79	1,676,246.21
Replacing Ordnance and Ordnance stores, 1904-5.....	519,339.42	454.50				31,312.36	11,108.15	1,030,706.51
Replacing Ordnance and Ordnance stores, 1905-6.....	45,801.61	1,993.30				31,312.36	419,838.45	7,712,571.33
Manufacture of arms, 1904-5.....	2,064,569.25	6.00				946,136.30	319,068.90	2,532,724.72
Manufacture of arms, 1905-6.....	71,847.76					196,136.95	1,496,692.74	1,700,680.45
Artillery targets, 1905.....	55,283.97					15,294.42	100.00	13,500.00
Ammunition for morning and evening gun, 1905.....	6,554.80					16,102.76	6,742.45	44,619.38
Replacing Ordnance and Ordnance stores destroyed by fire at Rock Island Arsenal, Ill., 1905-4.....	44,619.38					14,450.63		119,874.52
Ordnance material (proceeds of sales).....	103,918.11	80.58			\$13.20	80,833.42	248,082.05	536,000.00
Field Artillery for organized militia, 1904-5.....	246,108.52					26,569.89	62,506.19	527,700.20
New arms and equipments for organized militia.....	446,837.12					20.80		40,000.00
Converting muzzle-loading guns for saluting purposes, 1905.....	55,382.79						4,618.41	2,500.00
National trophy and medals for rifle contests, 1905.....	2,304.00						12,000.00	12,000.00
Medals of honor for distinguished services.....							1,273.00	12,000.00
Repairs of Ordnance, 1905.....	110,610.22					19,116.78		12,000.00
Board of Ordnance and Fortification.....	124,980.67					8,893.05	898,682.21	634,379.10
Armament of fortifications.....	8,724,261.51	91,773.48				600,682.61	7,624,726.14	12,622,125.46
Fortifications in insular possessions.....	87,873.90	6,099.76				11,866.61	6,475.44	605,669.41

REPORT OF THE CHIEF OF ORDNANCE.

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The total amount of the appropriations for the fiscal year 1905, including those contained in the act making appropriations for fortifications and other works of defense approved March 3, 1905, amounted to \$9,627,709. The total amount with which the appropriations were credited in accordance with authority of law from sales, transfers, etc., was \$1,405,133.37. The total of the payments made by disbursing officers and by Treasury settlements during the year amounted to \$11,849,642.09. The total sales of condemned stores during the year amounted to \$172,473.61, all of which was credited on the books of the Treasury Department to "Ordnance Material (Proceeds of Sales)." The total amount to the credit of disbursing officers on June 30, 1905, was \$1,727,145.67, and the total amount in the Treasury on the same date amounted to \$12,919,160.52.

FUNDS ON HAND AT THE BEGINNING AND CLOSE OF THE FISCAL YEAR.

The principal amounts on hand at the beginning of the year pertained to the following appropriations:

Manufacture of arms, 1904-5-----	\$2, 522, 712. 41
Field artillery for organized militia, 1904-5-----	585, 900. 00
New arms and equipments for organized militia-----	527, 705. 08
Board of Ordnance and Fortification-----	422, 940. 47
Armament of fortifications-----	9, 004, 553. 16
Fortifications in insular possessions-----	418, 920. 00

The status of these appropriations at the close of the fiscal year will be seen by reference to the tabular statement, and will be discussed later under the above heading.

The principal amounts on hand at the close of the fiscal year pertained to the following appropriations:

Ordnance stores—ammunition, 1905-----	\$424, 908. 56
Replacing ordnance and ordnance stores, 1905 and 1906-----	664, 961. 37
Manufacture of arms, 1905-1906-----	1, 626, 012. 69
Armament of fortifications-----	8, 231, 761. 19
Fortifications in insular possessions-----	617, 546. 01
Field artillery for organized militia, 1905-1906-----	500, 346. 99

The above amounts under the appropriations "Armament of fortifications" and "Fortifications in insular possessions" include the sums of \$2,988,550 and of \$236,000 which had been appropriated at the last session of Congress under these appropriations, respectively. Under the law these appropriations are available on the approval of the act making them and until used.

The appropriation for field artillery for the organized militia was also made at the preceding session of Congress and made immediately available.

The balances under the fund "Replacing ordnance and ordnance

stores, 1905 and 1906," and the appropriation "Manufacture of arms, 1905-1906," are available for the fiscal year of 1906.

Of the above amounts reported on hand at the close of the fiscal year the greater portion, in nearly every case, has been allotted to meet outstanding obligations. The available balances under the above-named appropriations at the close of the fiscal year are as follows:

Ordnance stores—ammunition, 1905	\$3. 40
Replacing ordnance and ordnance stores, 1905 and 1906	229, 649. 07
Manufacture of arms, 1905-1906	246, 930. 47
Armament of fortifications	3, 685, 184. 29
Fortifications in insular possessions	441, 253. 70
Field artillery for organized militia, 1905-1906	231, 736. 47

It will be seen, therefore, in case of the above-named appropriations, that they were largely obligated at the close of the fiscal year, except in case of the appropriations which had been made and increased at the preceding session of Congress.

TRANSFERS AND SALES OF ORDNANCE STORES.

The value of ordnance stores transferred to the executive departments is refunded to ordnance appropriations by Treasury settlements, and the funds received become available upon receipt and remain so during that and the following fiscal year for replacing the stores so transferred. The total value of the stores thus transferred amounted to \$1,125,227.68. Of this amount, \$201,813.70 were on account of transfers to the Navy Department, \$35,745.05 on account of transfers to the Marine Corps, \$11,849.64 on account of transfers to other executive departments, and \$852,042.48 on account of transfers to the organized militia. In conducting experiments for the Board of Ordnance and Fortification the value of the ordnance stores which were used in them amounted to \$1,466.65, which was transferred from the appropriations for the Board to the ordnance appropriations proper.

The total amount of sales made to the organized militia, to the Philippine government, to officers of the Army, to American designers engaged in the development of military inventions, etc., amounted to \$279,905, all of which was refunded to ordnance appropriations.

The total of the transfers and sales amounted to \$1,405,133.37, which is nearly 15 per cent of the total amount appropriated for this Department for the arming, equipping, and supplying of the Regular Army.

PAYMENTS.

The total amount of payments made by disbursing officers amounted to \$11,671,317.27 and by Treasury settlements to \$178,324.82—a

total of \$11,849,642.09. As the appropriations proper for the year amounted to \$9,627,709, it will be seen by reason of the procurement of ordnance and ordnance stores to replace articles transferred or sold to other departments, etc., that the disbursements were about 23 per cent in excess of the appropriations.

The amounts of the disbursements made at the principal arsenals and in the Ordnance Office during the fiscal year are as follows:

Frankford Arsenal.....	\$1, 726, 400. 00
Rock Island Arsenal.....	3, 757, 201. 05
Sandy Hook Proving Ground.....	201, 248. 82
Springfield Armory	1, 584, 990. 02
United States Powder Depot.....	105, 207. 71
Watervliet Arsenal	882, 163. 51
Watertown Arsenal	726, 699. 76
Ordnance Office.....	2, 147, 304. 70

AMOUNTS COVERED INTO THE SURPLUS FUND.

The principal amounts covered into the surplus fund of the Treasury were \$75,567.21 for the manufacture of small-arms ammunition and \$15,989.57 for the manufacture of cavalry, infantry, and artillery equipments.

COMPARISON OF THE FISCAL STATEMENT WITH THAT OF THE PRECEDING YEAR.

Comparing the fiscal statement with that of the preceding year it will be found that the amount of the appropriations was decreased from \$10,245,613.41 to \$9,627,709—a reduction of \$617,904.41; but the amount of the disbursements increased from \$9,757,560.87 to \$11,849,642—an increase of \$2,092,081.22. The last statement shows an increase of business of 21 per cent over that of the preceding year.

The amount received from transfers to the Executive Departments and the organized militia decreased from \$2,245,885.16 to \$1,125,227.68. The amount received in the preceding year was largely increased by reason of the rearming and equipping of the organized militia.

The amount available for disbursement at the close of the fiscal year decreased from \$15,355,730.94 to \$14,669,512.19—a decrease of \$686,218.75.

COMPARISON OF THE FISCAL AFFAIRS OF 1905 WITH THOSE OF 1900.

The records of money accountability afford a means of making a comparison of the extent and variety of the business of the Ordnance Department with that of prior years. The fiscal year 1900 was taken at random as one of comparison with 1905, and the following important data are furnished as a means of comparison:

The number of written contracts made by ordnance officers in 1900 was 421; in 1905, 675, an increase of 60 per cent. The number of remittances in 1900 was 607; in 1905, 796, an increase of 30 per cent. The number of allotments made in 1900 was 1,353; in 1905, 2,199, an increase of 63 per cent. The amount of the payments in 1900 was \$14,614,065.51; in 1905, \$11,849,642.09, a decrease of 19 per cent. The number of certificates of deposit increased from 332 to 551, an increase of 66 per cent.

The numbers of the money vouchers executed during each of the two years for the five arsenals are as follows:

Frankford Arsenal, 1,082 and 1,735, respectively, an increase of 60 per cent.

Rock Island Arsenal, 1,513 and 3,219, respectively, an increase of 112 per cent.

Springfield Armory, 1,207 and 1,197, respectively, a decrease of 1 per cent.

Watertown Arsenal, 993 and 2,039, respectively, an increase of 105 per cent.

Watervliet Arsenal, 719 and 1,350, respectively, an increase of 88 per cent.

The above statements show that even with a decrease in the amount of the payments made, the quantity of clerical work has greatly increased. This is due almost entirely to the greater variety of business. As cannon, small arms, gun carriages, and ammunition increase in efficiency their design becomes more complex, requiring a greater variety of materials to enter into their construction. Consequently to procure these parts a greater number of contracts, vouchers, etc., must be executed. The increase in the allotments made has been partly due to the above causes and also to a more careful system of accounting for funds.

SYSTEM OF ACCOUNTS.

Prior to the last fiscal year the system of accounting for funds allotted for various purposes to the different arsenals was at each of them different in detail, and, generally speaking, the system followed was to keep an account under the appropriation rather than under the allotment. That is to say, when an allotment was made to an ordnance establishment for any purpose it was duly credited to the account under the appropriation authorizing it. Under such a system all the importance was attached to the appropriation and very little to the allotment. This system naturally arose from the method of accounting under appropriations required by law, and this method of accounting was considered as the central system about which the minor accounting at the arsenals was to be made. While the rendering of accounts in the manner required by law is important and very

proper, nevertheless such accounts constitute merely summaries of many transactions and should have been treated as incidental to and arising from a more important detailed system of arsenal or local accountability.

It was realized that under such a system the officer controlling expenditures had very little knowledge of those incurred under each allotment, unless it was by means of a system of work orders which were given out on receipt of the allotment. In view of the fact that many of the allotments made by this Office for the manufacture of ordnance material would frequently authorize expenditures extending over a period of several years, the necessity of keeping an accurate account under each allotment was obvious.

Accordingly there was introduced at each arsenal a uniform system of accounting for funds allotted for various purposes, irrespective of the appropriation under which they were made. The account gives the proper balances remaining unexpended at any time, so that the officer controlling expenditures is kept fully informed as to the status of the allotment with respect to the work done.

Under this system the officer controlling expenditures, having the reports of the percentage of work done from the officers in charge of the manufacture or purchases, can readily ascertain at any time whether or not he has the necessary funds to complete the work. In all cases of large expenditures, where the amounts involved are large, no possibility of exceeding the allotment is admitted if the system is properly carried out.

This system was fully thought out and in operation before Congress enacted the recent law impressing upon officers in charge of expenditures the obligation of keeping expenditures within appropriations. Under the system above outlined it is not possible for an allotment to be exceeded when the records are kept up to date. It is obvious that as long as expenditures are kept within allotments appropriations can not be exceeded, for it is the primary duty of this Office to see that no allotments are made in excess of appropriations.

In order that this Office may be informed as to the status of the work carried on under various allotments a monthly report is required to be made of all operations under each allotment. On this report appears a summary giving the amount of each allotment, the obligations incurred under it, and the progress of work made, with the date, or probable date, of completion. This report is the connecting link between the accounts in this Office and those of the various arsenals, and in addition enables this Office to know what progress has been made under each job.

Heretofore the system of accounting for funds under appropriations at the different arsenals was not uniform. In some cases a record book was kept of the disbursements under each appropriation

and in other cases the records were kept in the form of duplicates of the monthly reports required to be made to the Treasury Department. The present system consists in furnishing each arsenal with a permanent binder, which gives the status of disbursements under each appropriation and is practically an account current and an abstract of disbursements combined.

It may here be stated that the introduction of this system has not entailed an increase in the clerical force at the different ordnance establishments, an object which has entailed much care and thought in the systematization of the processes.

COST SYSTEM.

All persons familiar with the conduct of manufacturing establishments are aware of the difficulty of arriving at the cost of articles which are manufactured, especially if the business of the establishment is extensive and of varied character. The system of accounting above referred to has been so arranged as to distribute with fair accuracy some of the general costs of manufacture, such as coal, civilian superintendence, etc., among the different articles which are manufactured. But in speaking of Government manufactures it is commonly stated that the reported cost does not represent the real cost to the Government, inasmuch as the reported cost is that which is paid out of the special appropriation authorizing the manufacture of the articles only; and the statement is in general true. For example, when gun carriages are manufactured at the Watertown Arsenal their reported cost is only that which has been paid out of the appropriation, generally made in the fortifications act, from which the money for their construction has been allotted; leaving out of consideration the pay of the superintending Army officers, and of the enlisted men engaged in the general care of the establishment, which come from the appropriation "Pay of the Army;" general repair and improvements of the buildings, from the appropriation "Repairs of Arsenals;" clerical expenses from the appropriation "Ordnance Service," etc. It is quite possible, however, to take these into account, and an effort has been made to do so, so as to include in the cost of articles manufactured all the above-mentioned expenses, and in addition interest upon the value of the plant, its deterioration, allowance for losses by fire, and in general all those expenditures which a private manufacturer must take into account, except profit. In the case of the Frankford Arsenal it has been found for the year 1904 that the cost paid from the allotments from the appropriations must thus be increased by 9 per cent, in order to cover the expenditures made from other and more general appropriations and the fixed charges; that for the Springfield Armory this figure is 14 per cent, and for the

Rock Island Arsenal it is 11.4 per cent. Recent price lists have been prepared with additions to the allotment costs due to the above percentages, and these price lists therefore represent the entire cost to the Government, from whatever source funds have proceeded.

EXAMINATION AND SETTLEMENT OF PROPERTY RETURNS.

At the beginning of the year the auditing of returns was for all practical purposes up to date except that 11 returns from arsenals and inspectors, and 240 returns from the Army, Militia, and colleges had not been closed, and 204 voluminous abstracts from arsenals for the first half of the past fiscal year had not been examined.

The following table exhibits briefly the work of the auditing of returns during the year:

	Number of returns not closed June 30, 1904.	Number of abstracts not examined June 30, 1904.	Received during year ended June 30, 1905.		Total.		Acted on during year.				Not closed, awaiting correspondence, June 30, 1905.	
			Returns.	Abstracts.			Finally examined.		Closed.			
					Returns.	Abstracts.	Returns.	Abstracts.	Returns.	Abstracts.	Returns.	Abstracts.
Arsenals and inspectors.....	11	204	46	326	57	530	46	530	54	229	8	301
Army, Militia, and colleges.....	240	-----	5,117	-----	5,357	-----	5,117	-----	5,184	-----	173	-----
Total	251	204	5,163	326	5,414	530	5,163	530	5,238	229	176	301

The three returns of arsenals and inspectors not closed had been examined. The delay in closing was due to correspondence affecting certain transactions in them. These returns are for Rock Island Arsenal, the Manila Ordnance Depot, and for the office of an inspector of ordnance.

The 176 returns from the Army, militia, and colleges which were not closed had all been examined. The delay in closing was largely due to the necessity of corresponding concerning certain transactions in them. But in case of certain of the States it is not possible to close their returns without the authority of Congress, as losses of property have accrued which can not be shown to be unavoidable on the part of the officers of the State. The return of one State for 1900 has not been closed on account of the loss of stores valued at \$437.92, for which settlement has not been made with the United States. In consequence the returns from the State for 1901-2 have not been closed. These are the only returns prior to 1903 which have not been closed. In case of another State no returns for 1903 or 1904 were rendered at the close of the year, and the

War Department took action on this delinquency by declining to make further issues to it. Recently a consolidated return for the two years has been received. The return for a third State for 1903 has not been closed on account of a charge against the State of \$128.55 for the loss of stores by one of its officers. In a communication from the State it was stated that suit for the above amount would be entered on the bond of the responsible officer.

It has been a matter of regret that in corresponding with officers of the Army concerning their returns replies have sometimes not been forthcoming as promptly as they should have been, and in fact in certain cases replies could not have been obtained without reporting the facts to the War Department. It has been found necessary to adopt the rule of writing to a delinquent officer twice, with an interval of one month. In case of the failure of a reply within a month after the second letter was mailed recommendation was made to have the officer's pay stopped to the extent of the amount involved in the correspondence.

The work of the property office was carried on with fourteen clerks, the reduced number which I reported as necessary in my last report.

SMALL ARMS.

United States magazine rifle, model of 1903.—On June 30, 1904, 30,000 of these rifles had been completed at the Springfield Armory. The capacity for its manufacture gradually increased at both the Springfield Armory and the Rock Island Arsenal until an output of 400 per day was attained at the former place in November, 1904, and 125 per day in January last at the latter place. Changes made in four important features allowed only 34,000 finished arms to be assembled during the fiscal year. The manufacture of all parts not affected by the changes was, however, continued, and at the end of the year such parts for 66,000 arms had been made at Springfield Armory and for 18,000 at Rock Island Arsenal. Sufficient arms for equipping the Army having been completed in January last, preparations were made for their issue, but in view of changes contemplated in the bayonet their issue was suspended.

The changes referred to above were:

First. To satisfactorily fulfill the new condition imposed by the revised Infantry Drill Regulations that the piece be habitually carried loaded and "cocked," it was necessary to redesign the cocking piece and safety lock to stand the wear of such repeated setting and unsetting.

Second. At the suggestion of the President of the United States further consideration by the General Staff of the length of the barrel and of the design of the bayonet resulted in the substitution of a

knife for the rod bayonet. The new bayonet is of the same type as that used with the model of 1898 rifle, except that the length of its blade is 16 instead of 12 inches, its cutting edges are sharp, and the catch for securing the bayonet to the rifle also serves to retain it in the scabbard. The bayonet will not be issued to mounted troops. The papers relating to this change form Appendix I hereto.

Third. A board of officers was convened on May 2, 1905, at Fort Leavenworth, Kans., upon my suggestion for the purpose of ascertaining that form of sight most suitable for use in actual service, the relative excellence for target and range work being considered with reference to the training of the soldier to shooting under battle conditions. The sight adopted upon recommendation of the Board is a modified form of that known in service as the model of 1901. The report of the Board forms Appendix II hereto.

Fourth. The stud carrying the front sight was redesigned to permit sufficient lateral adjustment of the latter to enable the center of impact of each rifle at a range of 200 yards to be brought within prescribed limits before being accepted for issue.

The alterations in the two plants necessitated by the above changes are progressing rapidly, and it is believed they will be completed by December next. It is anticipated the changes will be embodied by April next in sufficient arms to then begin equipping the Army.

A new design of front-sight protector has been adopted, which, it is believed, will effectively prevent the front sight from cutting the leather scabbard used by the mounted troops.

Two important tests of finished arms were adopted during the year that should further raise the standard attained in the manufacture of arms at the national armories. A star gauge has been perfected which enables the diameter of the bore of the small arm across the top of the lands and across the bottom of the rifling grooves to be accurately measured; the use of this gauge insures the rejection of barrels the dimensions of the bores of which do not throughout fall within prescribed limits. At each national armory a proof house with butts has been erected to provide an inclosed range of 200 yards, over which each rifle, before being accepted, will be fired for accuracy by expert marksmen. In case the center of impact of a group of shots fired from any rifle falls outside of established limits, the front sight will be moved laterally until the deviation is corrected; the sight will then be rigidly secured. All rifles that do not attain the prescribed standard of accuracy in this test will be rejected. It is anticipated that these tests will materially reduce the difference in the shooting qualities formerly found to exist in some arms.

Accuracy and erosion tests.—Exhaustive tests have been conducted during the year to determine the number of rounds that can be fired

before the accuracy of the barrel of the model of the rifle is appreciably impaired. It appears that the loss of accuracy is principally due to the enlargement of the bore at and immediately in front of the bullet seat, produced by the expansion of the powder gas, which enlargement results in some loss of entering the non-eroded portion of the bore with the longitudinal axis inclined to that of the bore, and in the rifling distorted to some extent as to caliber and rifling pitch. The tests so far completed form Appendix III hereto.

Extended firing tests have shown that a muzzle velocity of 200 feet per second less than originally contemplated does not materially decrease the remaining energy or increase the curvatures of trajectories at ranges up to 1,000 yards. This reduction makes no appreciable decrease in the remaining energy of the bullet at ranges greater than 1,000 yards, and the chief factor of result is that can be fired before the barrel is sufficiently eroded to seriously affect the accuracy for target practice, and thus leaves the arm more powerful than any other service military rifle yet known to the Department. It has therefore been decided to adopt a muzzle velocity of 2,000 feet per second for the United States magazine rifle model of 1906, and the extended experiments with service rifle and magazine rifle in powder and barrel steel are now being continued to determine the proper velocity.

Some of the results of the tests of the new rifle section by the General Staff from a magazine rifle of this new type and for the new bayonet has been adopted which has a wooden body, first covered with rawhide and then with rubber, and which it has a rubber grip and a steel hook for attachment to the waist belt. The bayonet is retained in the same position as in the magazine rifle, and the barrel of the rifle.

The new rifle is being tested by the General Staff for the United States magazine rifle model of 1906 are being provided with the same hook as the new bayonet, to enable them to be worn on the new design of cartridge belt.

Remarks.—It is anticipated that the experimental firing during a longer and longer period of time will show a possible effect of the powder gas on the barrel effect will be considered at an early date. The results of the tests so far made will show that no loss of accuracy is due to the loss of the barrel of the rifle, and the requirements are met.

Summary.—The new rifle of 1906 is a rifle of self-loading type, and has been tested in the Department during the year, and the results of the tests of the rifle are being made in the Department.

Remarks.—The new rifle is being tested by the General Staff for the United States magazine rifle model of 1906 are being provided with the same hook as the new bayonet, to enable them to be worn on the new design of cartridge belt.

knife for the rod bayonet. The new bayonet is of the same type as that used with the model of 1898 rifle, except that the length of its blade is 16 instead of 12 inches, its cutting edges are sharp, and the catch for securing the bayonet to the rifle also serves to retain it in the scabbard. The bayonet will not be issued to mounted troops. The papers relating to this change form Appendix I hereto.

Third. A board of officers was convened on May 2, 1905, at Fort Leavenworth, Kans., upon my suggestion for the purpose of ascertaining that form of sight most suitable for use in actual service, the relative excellence for target and range work being considered with reference to the training of the soldier to shooting under battle conditions. The sight adopted upon recommendation of the Board is a modified form of that known in service as the model of 1901. The report of the Board forms Appendix II hereto.

Fourth. The stud carrying the front sight was redesigned to permit sufficient lateral adjustment of the latter to enable the center of impact of each rifle at a range of 200 yards to be brought within prescribed limits before being accepted for issue.

The alterations in the two plants necessitated by the above changes are progressing rapidly, and it is believed they will be completed by December next. It is anticipated the changes will be embodied by April next in sufficient arms to then begin equipping the Army.

A new design of front-sight protector has been adopted, which, it is believed, will effectively prevent the front sight from cutting the leather scabbard used by the mounted troops.

Two important tests of finished arms were adopted during the year that should further raise the standard attained in the manufacture of arms at the national armories. A star gauge has been perfected which enables the diameter of the bore of the small arm across the top of the lands and across the bottom of the rifling grooves to be accurately measured; the use of this gauge insures the rejection of barrels the dimensions of the bores of which do not throughout fall within prescribed limits. At each national armory a proof house with butts has been erected to provide an inclosed range of 200 yards, over which each rifle, before being accepted, will be fired for accuracy by expert marksmen. In case the center of impact of a group of shots fired from any rifle falls outside of established limits, the front sight will be moved laterally until the deviation is corrected; the sight will then be rigidly secured. All rifles that do not attain the prescribed standard of accuracy in this test will be rejected. It is anticipated that these tests will materially reduce the difference in the shooting qualities formerly found to exist in some arms.

Accuracy and erosion tests.—Exhaustive tests have been conducted during the year to determine the number of rounds that can be fired

before the accuracy of the barrel of the model of 1903 rifle is appreciably impaired. It appears that the loss of accuracy is principally due to the enlargement of the bore at and immediately in front of the bullet seat, produced by the erosive action of the powder gas, which enlargement results in some bullets entering the noneroded portion of the bore with the longitudinal axis inclined to that of the bore, and in their being distorted to such an extent as to cause irregular flight. The tests so far completed form Appendix III hereto.

Extended firing tests have shown that a muzzle velocity 100 feet per second less than originally contemplated does not materially decrease the remaining energy or increase the ordinates of trajectories at ranges up to 1,000 yards. This reduction makes no appreciable decrease in the remaining energy of the bullet at ranges greater than 1,000 yards, doubles the number of rounds that can be fired before the barrel is sufficiently eroded to noticeably affect the accuracy for target practice, and still leaves the arm more powerful than any other service military musket known to the Department. It has therefore been decided to adopt a muzzle velocity of 2,200 feet per second for the United States magazine rifle, model of 1903, until such extended experience in service is had and improvements in powder and barrel steel are made as will warrant a return to the higher velocity.

Scabbard for knife bayonet, model of 1905.—Upon selection by the General Staff from a number submitted, a scabbard for the new bayonet has been adopted which has a wooden body, first covered with rawhide and then with russet leather; it has a metal mouthpiece and a steel hook for attaching it to the waist belt. The bayonet is retained in the scabbard by a spring catch in the handle of the former.

Bayonet scabbard, model of 1898.—Bayonet scabbards for the United States magazine rifle, model of 1898, are being provided with the same hook as the new scabbard, to enable them to be worn on the new design of cartridge belt.

Revolver.—It is anticipated that the experiments for determining a design and caliber of revolver bullet which will possess sufficient stopping power and shock effect will be completed at an early date. The results of the tests so far made would seem to indicate that no bullet having a caliber less than .45 can be found to fulfill the requirements imposed.

Self-loading magazine rifles.—Different designs of self-loading muskets have been subjected to preliminary tests during the year, and the results indicate that material progress is being made in their development.

Fencing muskets.—These muskets will hereafter be made of Springfield rifles, caliber .45, altered to the length and weight of the United States magazine rifle, model of 1903. The method employed in the

manufacture of fencing bayonets has been greatly improved during the year.

Automatic machine guns.—One hundred and twenty automatic machine guns, caliber .30 (Vickers, Sons & Maxim), with tripod mounts, spare parts, and pack outfits, are under manufacture for issue to cavalry and infantry; 55 of these guns, with wheeled mounts, are being made for use in and around seacoast forts. The wheeled mount was specially designed for man draft on sandy beaches, and has been made as light as consistent with requisite strength.

Sabers.—In view of the instructions of the President of the United States that the utility of the design of saber used in our service be considered, the manufacture of the 20,000 sabers and the 23,000 scabbards referred to in my last report was suspended from February 24 to July 17, 1905.

The General Staff found the blade of the light cavalry saber to be satisfactory, but recommended a new design of grip and guard, and a wooden scabbard. One thousand and thirty-nine of these sabers for enlisted men and 157 for officers are being made at the Springfield Armory, and the scabbards therefor at the Rock Island Arsenal for issue to troops for trial. The papers relating to this design of saber form Appendix IV, hereto.

SMALL-ARMS AMMUNITION.

Ball cartridges, models of 1898 and 1903.—The thickness of the metal of which the bullet jacket is made was increased to prevent, as much as possible, the stripping of the jacket from the lead core in eroded barrels. A machine is being designed to form the bullet cores from wire-drawn lead rods, as it is believed this method will result in greater uniformity in the weight of the bullets.

The packing box for these two models of cartridges was changed to a form that can be more conveniently packed on mules; this box is opened at one end to permit easy access to the cartridges without removing the box from the pack.

Guard cartridges, models of 1898 and 1903.—The bullet has been lengthened to enable the cartridge to be fed from the magazine; it is also more accurate than the former.

Dummy cartridges, models of 1898 and 1903.—As the bolt of the rifle occasionally caught in one of the holes near the head of the shell, these holes are now drilled through the bottoms of the corrugations.

Gallery practice cartridge.—With a view to reducing the cost of ammunition for gallery practice without sacrifice in accuracy, an exhaustive series of experiments was conducted at the Springfield Armory with several kinds and calibers of cartridges, some of which required the use of chamber plugs, some of subcaliber tubes, and some of barrels specially bored and chambered. The results of the tests

showed the choice to lie between the present service gallery-practice cartridge and the caliber .22 rim fire, long cartridge, and that no material difference in accuracy existed at 25, 50, and 75 feet. As the caliber .22 cartridge costs much less than the powder, bullet, and primer required for loading the gallery-practice cartridge, and as reports indicate that unsatisfactory results are obtained with ammunition loaded by troops, this cartridge has been adopted for gallery practice. When the new rifle is issued, each company or troop will receive four barrels and receivers for the caliber .22 cartridge, which can be assembled to service arms in place of the caliber .30 barrels and receivers for use in gallery practice. Each organization will be allowed 10,000 caliber .22 cartridges per annum. Caliber .22 barrels will be supplied the militia of the several states upon requisition, under section 1661, Revised Statutes, as soon as they can be manufactured for the model of 1898 rifle.

Tests to determine comparative accuracy of small-arms ammunition made by the Department and by private manufacturers.—On July 9, 1904, a test was conducted at Sea Girt, N. J., by a committee of the National Board for the Promotion of Rifle Practice, to determine whether the ball cartridges, model of 1898, made at Frankford Arsenal were equal in accuracy at long ranges to those made by four different private makers. The committee unanimously decided that the Government ammunition was not as reliable at 1,000 yards as that of private makers.

Fifteen targets were made by the committee, and as all of the shots fired for each target were direct hits in only two of them, the correctness of the conclusions drawn from such incomparable data seemed inadmissible, especially as it was admitted by one firm that the cartridges of its make which had been used in the tests were specially loaded by hand. The tests were therefore repeated at the Springfield Armory under the conditions prescribed by the committee, with results much more favorable to the ammunition made at the Frankford Arsenal. The tests were again repeated about six months later, the ammunition of private makers being purchased from dealers and that made at Frankford Arsenal being taken from lots manufactured before the date of the first test. The second test was again creditable to the Government product.

It is claimed that the shell and primer for caliber .30 ammunition made at Frankford Arsenal are not excelled by those produced by any private manufacturer. It is therefore believed that any material improvement made in the Government cartridge must be confined to its two other components, powder and bullet, and to the method of loading. The Department is constantly urging powder makers of this country to improve their product, and it is believed they are endeavoring to meet the Department's wishes. Although reports

indicate that some foreign-made powders give better results than those made in this country, it is not deemed wise to adopt a foreign powder, since the home product only could be depended upon in time of war. And, moreover, home industry should be encouraged in military material, and there is good prospect of its improvement.

It is claimed by some that greater accuracy is obtained with a bullet with the part next to the base cylindrical instead of conical, as in the Frankford Arsenal bullet. One of the first requisites for service ammunition is that it shall be waterproof, and no reliable method has yet been found by which this fundamental requirement can be obtained with a cylindrical bullet. An exhaustive series of experiments made with different designs of bullets has shown that the Government design gives equal, if not greater, accuracy to any. The accuracy of the Government ammunition could be improved by substituting hand loading by weight for machine loading by volume, but the cost of the ammunition would be greatly increased thereby. To hand load the daily output of cartridges in time of war would be utterly impracticable. Efforts have therefore been made for some time past to design or obtain a machine by which cartridges can be satisfactorily loaded in quantity by weight, but so far without success. Improvements in the method of loading cartridges are, however, receiving the constant attention of the Department.

Contracts for ball cartridges, model of 1903.—That private plants in this country might be equipped for and have experience in the making of small-arms ammunition, which is needed so desperately and in such large quantities in time of war, contracts have been made with each of the following firms for furnishing the Department with 3,216,000 ball cartridges, model of 1903, viz, the Union Metallic Cartridge Company, the Winchester Repeating Arms Company, and the United States Cartridge Company.

Although the price bid by each of the three companies was the same and considerably higher than that for which the cartridge is being made at Frankford Arsenal, yet it was deemed to the advantage of the Government to make the contracts, for the reasons stated above and in order that the Government product might be sustained and improved by comparison with the best that can be produced by private effort.

SMALL-ARMS TARGET PRACTICE.

Telescopic sight for issue to expert riflemen.—The telescopic sight referred to in my last report as being designed by the Warner & Swasey Company, of Cleveland, Ohio, proved satisfactory, and 25 are being procured for issue. The telescope can readily be detached from the rifle and carried in a leather case.

Special revolver for issue in lieu of gold medals.—A handsomely engraved design of Colt's caliber .38 service revolver has been adopted

for issue in lieu of gold medals. These revolvers are specially selected for their accuracy.

Target material.—The targets, target frames, silhouettes, etc., supplied by the Department for small-arms target practice have proved satisfactory during the year so far as the Department is informed.

EQUIPMENTS.

No changes of any importance have been made during the year in the equipments issued to cavalry, infantry, and artillery. The improvements made in the different equipments during the past few years appear to have proved satisfactory and serviceable. The economical policy adopted of gradually introducing equipments made of russet leather into the service by restricting their issue to that necessary for replacing those of black leather worn out by fair usage has resulted in some cases in detracting from the appearance of organizations. It is believed the number of black-leather equipments in the possession of troops will be so small that their replacement by January next will be justified, and such action will be taken.

The extraction of surplus oil from equipments made of stuffed russet leather, by the process referred to in my last report, has removed a source of much complaint.

INTRENCHING TOOLS.

Upon the recommendation of a special committee of the General Staff, intrenching tools have been adopted as a part of the soldier's equipment to be supplied by this Department. Each company of infantry, or of any other arm serving as infantry, is to be provided with the following, viz, 1 two-foot rule, folding; 4 hand axes; 3 wire cutters; and 1 pick mattock, and 3 shovels for each squad.

Steps have been taken to provide a sufficient supply of these tools for equipping the Army and part of the organized militia.

Sample carriers for the shovel, pick mattock, and hand ax have been submitted for approval. The papers relating to the adoption of these tools form Appendix VI.

SERVICE GUNS AND MORTARS.

These have been maintained in a satisfactory state of efficiency during the year. The firing mechanisms referred to in my last report, having been assembled, add much to the ease and rapidity of operation, and, together with the new primers which were designed for use with them, have given satisfaction. An accident, however, occurred at Fort Wetherill soon after the firing mechanisms had been assembled to the guns at that place, as a result of which a 10-inch gun on a disappearing carriage while in the "from battery" position was prematurely fired. The investigation following the accident

showed that it was caused by wrapping one or two turns of wire of small diameter under the head of the button on the primer wire, thus shortening the effective distance between it and the end of the primer. The wire wrapped around the stem held the button away from the rear face of the firing leaf and drew the head of the primer upon the bevel surface on the lower end of the slide, so that when the latter was pushed downward the primer was forced to the front, drawing the detonating composition over the primer wire. This accident has not caused this Department to alter its previously expressed opinion, which has been confirmed by numerous trials, that the primers issued by it to the service, if used in connection with these firing mechanisms under normal conditions and without alteration, are safe and satisfactory.

Continued exercise with the armament has indicated that breech-blocks, when the threads are made very smooth and are well lubricated, have a tendency to rotate, notwithstanding that the pitch angle of the threads of the blocks is very small. No accidents from this cause have occurred in service, but as a matter of precaution automatic locking devices have been designed and are being applied to all guns of models of 1895 and 1900, the ones with which the tendency exists. The important improvements which have been made in rapid-fire guns of small caliber since 1898 have made it necessary for the Department to design changes in a large number of 15-pounder guns and mounts purchased during that year in order to increase their efficiency and to remove a certain lack of satisfaction which has existed in service, since a comparison has been made with those of more recent type. The principal change in the guns will be in improved firing mechanisms which will be applied simultaneously with changes in the mounts, and as rapidly as funds will permit.

Since the beginning of gun construction the art has at various times encountered elements which for the time being have placed a limit upon its advance. For a long time the element was the strength of the guns to resist bursting, the powders in use being capable of developing higher pressures than the guns could be made to withstand, and the charges therefore being necessarily kept within small limits and giving correspondingly low velocities to comparatively light projectiles. There was gradual improvement in the methods of construction by the use of better materials, by improved methods of casting iron guns, by reinforcement with wrought-iron jackets, and finally by the introduction of the present high class of steel forgings and the system of building up of concentric cylinders under shrinkage. These advances were accompanied by improvements in the powder whereby its rate of burning was better controlled and larger charges were employed, which, giving off their gases more gradually, would sustain for a longer period the pressures which the guns would

endure, and would thus continue the accelerating action upon the projectile. The improvement in powders naturally brought about both the carrying forward toward the muzzle of the strong section of the gun and the lengthening of it so as to hold the projectile longer subject to the accelerating force. These advances brought about a temporary check in regard to the projectiles, perhaps more feared than realized, these being apparently unable to withstand the impact produced by their high velocities against first-class armor. But such improvement of them was speedily made as to remove this limit upon the power of guns.

Accompanying the use of the larger charges of powder there was introduced a new element limiting the life of guns, namely, that of erosion of the bore. This was very great in the neighborhood of the seat of the projectile, and very decided in its action, scoring and guttering the surface in a manner which required its renewal after a certain number of rounds. The life fixed by this process, however, was not unreasonably short, a 10-inch gun being capable of enduring from 250 to 300 rounds before requiring relining, so that the question of limiting the power because of this difficulty was scarcely considered. With the general use of smokeless powder, however, with its still better control of the rate of burning, and the great increase in the powder charges and in the velocity, the subject of the wear of the bore has greatly increased in importance. This wear is of a different kind from that described above, being unaccompanied by the deep guttering of the surface which was experienced with the powder immediately preceding, but the smooth and even wearing away of the surface proceeds with such rapidity that after some 50 or 60 rounds from large guns the rifling is so worn away that the projectiles are no longer given the motion of rotation necessary to steadiness of flight, and inadmissible loss of accuracy results. There has, therefore, been brought about a serious consideration of the question whether the guns should not be used at a power less than that which their strength enables the realization of in order to diminish the erosion and increase the life.

It must be remembered that in thus using the guns at less power the energy of the projectile is reduced by a sacrifice of that quality which it loses soonest in flight in any event, namely, the velocity; and it must also be remembered that it is quite possible to retain the superiority of the gun over anything which it is called upon to attack by using larger calibers for given work and by building guns of larger size than is now customary, experimental constructions, as well as theory and natural foresight, having shown that the present conventional maximum need by no means be accepted as a limit. These questions are receiving serious consideration in order to make wise selection among courses which are open. Satisfaction can be

felt that we have thus far escaped serious accident and annoying and disturbing fissures of the tubes of our large guns which have been reported elsewhere, whether because of better and more careful manufacture or of fortunate chance it is difficult to say.

EXPERIMENTAL GUNS.

10-inch Brown segmental-tube wire gun.—No progress has been made in the test of this gun during the year, the repairs to the breech mechanism not having been made.

6-inch Brown segmental-tube wire gun.—This gun was delivered at the Sandy Hook Proving Ground on October 4, 1904, and is now undergoing test under a programme approved by the Board of Ordnance and Fortification.

6-inch wire-wound gun, Crozier design.—This gun was manufactured at Watervliet Arsenal under an allotment from the Board of Ordnance and Fortification, and was delivered at the proving ground on February 21, 1905, since which time it has been undergoing test under a programme approved by that Board.

Semiautomatic 15-pounder R. F. gun.—This gun has been under test at the proving ground since June 3, 1905. It is of a somewhat higher power than guns of this caliber which have been made heretofore, and some delay in its test has resulted from the lack of a suitable powder and because of some alterations in the semiautomatic features of the breech mechanism. The mount was designed as a type for all rapid-fire guns less than 5 inches in caliber, and it promises to prove satisfactory.

Semiautomatic 6-pounder guns and mounts.—Four of these guns and mounts are being procured under allotments made by the Board of Ordnance and Fortification and are designed to give to the projectile a muzzle velocity of 3,000 feet per second. One of these guns and mounts has been delivered, and the remaining ones are expected to be delivered within a reasonable time. Advantage is being taken of the delay in delivery to determine a suitable powder for their tests, no powder of the proper granulation being on hand. Several experimental samples of powder have been obtained for this purpose.

3-inch field gun, Ehrhardt.—A gun of this design, mounted on a long recoil carriage, was tested during the year. As compared with the service rotation block this sliding breechblock design requires less care to prevent interference by dirt or rust, but the cartridge can not be quite so readily inserted. Interference and stoppage sometimes occurred when the cartridge was not properly seated or the block not fully open. The block operated as smoothly and positively in the one hundred and eighty-seventh round of the test as in the first. The firing mechanism with the sliding block is believed to be safer than any other, but the question is not considered a settled

one whether or not the sliding breechblock compensates for its weight and for the mortise through the gun for the recess.

*3-inch breech mechanism, retracting bushing (Gerdorn design).—*This mechanism was tested by firing 271 rounds with generally good results. The principal new feature is the continuous-pull firing arrangement combined with the retracting bushing that contains the firing pin and spring, and is retracted about 0.3 inch from the front face of the block when the breech is opened. As a result of the trials the bushing was slightly set back, as shown by the impression made on the base of the cartridge case and impressions of the lugs in the block on the cam surfaces that support the bushing in the block. The breech mechanism is simple, and the trials show that it is entitled to a high figure of merit as compared with others that have been tested by the Department, but is not considered to be as satisfactory as the adopted type. The possibility of premature fire in closing the breech is avoided, at least until the block is nearly locked, and is, in any event, remote. The firing pin is, however, central, and should the point be broken and jammed, there would be a screw pressure of this point against the primer after engaging the breech threads in rotating the block. The principal objectionable feature, in the opinion of the board under the direction of which tests were made, is the movable bushing, which detracts from desirable solidity in the face of the block to support the cartridge case and gives reasonable ground for doubt as to endurance of the mechanism itself in extended service.

MOUNTAIN GUNS.

In connection with experiments to determine the suitability of mountain guns as field mortars, the Department has considered whether or not it would be desirable to change the caliber of these guns from 75 mm. to 3 inches, in order to enable them to use field-gun projectiles. Some time since the weight of the mountain-gun projectiles was made the same as that of the field guns, namely, 15 pounds, as the result of experience with these guns in the Philippine Islands. Originally there were six different kinds of projectiles of several different weights used with this mountain material, and while it will always be found that a particular form of projectile will best meet the requirements of certain conditions, it must be expected that at times in the service there will be a lack of a sufficient amount of the particular kind of projectile which would best meet these conditions. A large number of kinds of projectiles increase the difficulties of manufacture and issue. It was these considerations which led to the adoption of the weight for shell and shrapnel above mentioned, the idea being that these would be projectiles of average weight and effect. The change in caliber can be made at a very slight expense,

and the firings with one gun so altered have demonstrated that the accuracy with a 15-pound shell having a muzzle velocity of 850 feet per second is satisfactory. The change in the caliber of these guns is somewhat complicated by the resulting changes in a large amount of shrapnel on hand for the 75-mm. mountain guns.

Previous difficulties in packing the ammunition for these guns, due to the different weights of projectiles and the special carriers that were required, have now been overcome by arranging the original shipping boxes, in which the projectiles are packed at the place of manufacture, so that these boxes can be hung directly to the new form of pack saddle without repacking.

MOUNTAIN ARTILLERY.

Although the carriage for the 75-mm. mountain gun is of comparatively recent design, its utility and rate of fire could be materially improved by increasing the maximum elevation at which the gun can be fired to 45° and increasing the length of recoil of the gun on the carriage, thereby making the latter more stable. This increased stability will enable the adoption of improved sights, permitting the use of both direct and indirect fire. Lack of officers in the Department has prevented the undertaking of the study necessary to determine the practicability of these improvements.

FIELD ARTILLERY.

3-inch field artillery material.—The manufacture of this material has progressed satisfactorily during the year. The efforts made by the Department to interest American manufacturers in the making of all the material required in its production have proved successful, as counter-recoil springs and panoramic sights can hereafter be obtained in this country. Appropriations have so far been made for 35 batteries of this material for the Regular Army and for 34 batteries for the militia; also for the extra caissons and limbers required to complete the equipment of each of 26 of the militia batteries, but 6 caissons per battery will be issued to the militia, instead of 12.

The first battery of this material was completed and issued to the Seventh Battery of Field Artillery at Fort Riley, Kans., in July and August, 1904, for use by the board for the preparation of drill regulations for Field Artillery. Upon the completion of the board's work for that year at Fort Riley, Kans., the guns and carriages were replaced and returned to Rock Island Arsenal for a thorough examination. The 6 batteries, constituting the Second Provisional Regiment of Field Artillery, at Fort Sill, were equipped in July, and the remaining 5 batteries of the First Provisional Regiment, at Fort Riley, in September of this year; the other 12 batteries of the Army

will be equipped before January 1 next. Preparations are now being made for the issue of the material manufactured for it to the militia of the several States and Territories, as may be directed by the War Department.

Advantage was taken of the use of this material by the board for the preparation of drill regulations for Field Artillery for test by that board of several important accessories, such as fuze setters, battery commander's telescopes, plotting boards, battery commander's rulers, means for carrying the sight and range quadrant, etc., designs of which articles have been perfected. Upon the recommendation of that board the door of the ammunition chest on the caisson was made of armor and hinged at the top, to increase the amount of protection furnished ammunition servants.

2.38-inch field gun on long recoil carriage.—This material was designed at the suggestion of the Board of Ordnance and Fortification, made on December 3, 1903, for use in protecting seacoast forts against landing parties and land attacks; its lightness may make it valuable as a part of the mobile artillery system. The gun fires a 7½-pound projectile with a muzzle velocity of 1,700 feet per second; its caliber is the smallest for which it is believed an effective shrapnel can be made. The gun, carriage, and limber being made for trial will be completed next spring; the delay in the completion of the designs was due to the shortage of officers in the Department.

3.8-inch field artillery material.—This gun is to fire a 30-pound projectile with a muzzle velocity of 1,700 feet per second, and is for use under conditions where the 15-pounder projectile of the 3-inch gun would prove inadequate, but where a 60-pound projectile of a siege rifle would not be required, or, on account of the weight of the latter material, bad roads, lack of transportation, etc., it could not be brought into action. The carriage is of the same general design as that for the 3-inch field gun; the pilot gun and carriage now under construction will be completed in about two months.

Field howitzer material.—The mobile artillery of an army should contain a certain number of howitzers for searching out trenches, protected positions, etc., against which their high-angle fire is more effective than the direct fire of guns. This class of artillery has the other advantage that, for the same weight of gun, carriage, and limber, a projectile of double the weight of that of a rifle can be used. It is therefore intended to provide a 3.8-inch howitzer on a long recoil carriage, firing a 30-pound projectile, and having a muzzle velocity of about 900 feet per second, the weight behind the horses being the same as that for the 3-inch field gun; also a 4.7-inch field howitzer, on a long recoil carriage, firing a 60-pound projectile, with a muzzle velocity of about 900 feet per second, the weight behind the horses being the same as that for the 3.8-inch field gun. The lack of officers

with which the Department has suffered for the past several years, and is still suffering, has not permitted the designing of this important class of material to be completed.

Automobile forge and battery wagon.—It has not been practicable to complete the design of the vehicle referred to in my last report; it is hoped, however, that conditions will enable this interesting line of work to receive the early attention it merits, and an effort will be made to complete a design this winter.

SIEGE MATERIAL.

4.7-inch siege material.—One of these guns with its carriage has been finished and is now undergoing firing tests, upon the completion of which it is proposed to subject it to severe road test. The tests so far made of the carriage show it to be a highly creditable production; it was designed by Capt. C. B. Wheeler, Ordnance Department.

6-inch siege howitzer material.—A howitzer and carriage are being designed in this office, and their manufacture will be undertaken at an early date. The howitzer is to fire a 120-pound projectile, with a muzzle velocity of 900 feet per second.

The Department has reached a conclusion as to the elements which it desires to embody in this gun and carriage and is at work upon the design, the completion of which has been delayed by the same cause which has operated disadvantageously in other work, namely, the shortage of officers.

SEACOAST CARRIAGES.

No funds were appropriated at the last session of Congress for new installations of seacoast gun in this country. The carriages for installation in the insular possessions for which appropriations were made are under construction.

In addition to carriages being made at arsenals, contracts exist with the following private manufacturers, viz:

15-pounder R. F. guns and carriages, with the Bethlehem Steel Company.

4.5-inch shields for 5 and 6 inch barbette carriages, with the Midvale Steel Company and the Bethlehem Steel Company.

5-inch barbette carriages, model of 1903, with the Morgan Engineering Company.

6-inch disappearing carriages, L. F., models of 1903 and 1905, with the Wellman-Seaver-Morgan Company, the Bethlehem Steel Company, and the Detrick & Harvey Machine Company.

The completion of twenty-five 6-inch disappearing carriages, L. F., model of 1903, was delayed by the failure of two contractors, which necessitated their completion by another concern.

Contracts have been made at satisfactory prices for the remaining 4.5-inch shields required for all 5-inch barbette carriages.

The 6-inch disappearing carriage, L. F., model of 1905, differs radically in some respects from the model of 1903, referred to in my last report, in that the energy of recoil of the gun is principally absorbed by a single hydraulic recoil cylinder, placed vertically in the center of the counterweight, which is cored out for the purpose, instead of by the two horizontal cylinders heretofore formed in the top carriage. The counter recoil is controlled by separate cylinders located on the exterior of the chassis acting on the top carriage. The gun is retracted by hand power into loading position through a train of spur gearing acting directly on the counterweight, instead of by ropes attached to the upper ends of the gun levers. The sighting platforms are located near the front end of the chassis to afford greater protection to gunners and the sighting mechanism.

Carriage for the type 16-inch breech-loading rifle.—A disappearing carriage of the service type is being designed in this office upon which this gun is to be mounted. It is anticipated that the drawings will be completed this winter.

12-inch mortar carriage.—The increased appreciation of the defensive value of mortars has warranted the preparation of a design of an improved carriage for 12-inch mortar. The mortar will be mounted and will recoil in a cradle similar to that of barbette carriages for rapid-fire guns, and will be capable of being fired at from 45° to 70° elevation. The azimuth circle will be more fully protected, and the method of bringing the mortar to the angle required for loading and returning it to the desired elevation for firing will be improved.

4.5-inch shields for barbette carriages.—Comparative tests of two different designs of shields for 5 and 6 inch barbette carriages made by firing 5 and 6 inch projectiles at shields of each type mounted on a carriage showed the design prepared and being procured by the Department to be superior.

10-inch Emery disappearing carriage.—Mr. Emery has prosecuted work during the year on the 10-inch disappearing carriage of his design, being made under a contract in accordance with the provisions of the fortifications act approved April 21, 1904, in such manner as he has deemed best. Mr. Emery states that about two-thirds of the material required for its construction has been obtained.

TELESCOPIC SIGHTS.

3-inch objective telescopic sights.—The graduated reticule is being removed, and a system of direct illumination of the cross wires substituted for the field-of-view illumination to improve its qualities as a night sight. The deflection scale will be transferred to the rear end of the cradle, where it can be more easily read.

The experience so far had in service with these sights has been very satisfactory.

2-inch objective telescopic sight.—Tests having demonstrated that a good telescope of low power and large field of view is the best known form of night sight, a design of a telescopic sight having a 2-inch objective, a power of 6 diameters, and a field of view of 5° is being prepared and will be applied as fast as funds permit to all carriages in service on which are mounted rapid-fire guns of caliber less than 6 inches.

Telescopic sights, models of 1898 and 1898 M.—At the request of the Chief of Artillery, the interior deflection scales and least reading on the micrometer deflection screw are being altered to conform to the provisions of the new artillery drill regulations.

AUTOMATIC SIGHTS.

To practically determine the efficiency of automatic sights for sea-coast guns, one sight each of the designs of Lieut. Col. L. K. Scott, of Sir George S. Clarke, of England, and of Capt. W. C. Davis, Artillery Corps, have been procured and are now undergoing test. A fourth design, submitted by Capt. A. S. Fleming, Artillery Corps, is also receiving consideration, and is the simplest thus far submitted.

IMPROVEMENTS IN INSTALLED SEACOAST CARRIAGES.

Electric firing of seacoast guns.—The electric firing from a distant station of seacoast guns having been disapproved, a firing circuit for each individual mount for guns is being prepared. On account of the very small amount of current required to fire a primer and the danger apprehended from the use of a current of high voltage, the current for the firing circuit will be supplied by a battery of six dry cells.

ELECTRIC FIRING OF MORTARS.

The firing of mortars in salvo requires an electric-firing system, by which the mortars in any pit can be simultaneously fired from a point outside thereof. With such a system this Department has to do only with the parts attached to each mortar and carriage. A 360°-contact, safety-firing switch, cables, and conduits have been designed for installation as rapidly as funds will permit.

Electric traversing and elevating and depressing mechanisms.—The experience had in service with carriages on which guns of the larger calibers are mounted and the proficiency attained in their use indicate that the only electrical power equipment necessary for their efficient service is that for retracting the gun to the loading position for drill purposes. The reduced intervals at which the data required for laying a gun are now sent would seem to justify the providing on

the sighting platforms of even the largest mounts a slow-motion traversing handwheel and near the elevation scale a slow-motion elevating handwheel. A study of such designs is being made.

12-inch mortar carriage, model of 1896.—The excellent results obtained in service with the 12-inch mortar renders it highly desirable to sufficiently strengthen the carriage to permit the power and range of the mortar to be more fully utilized. One carriage, modified accordingly, has been tested with satisfactory results. It is therefore proposed to similarly alter all 12-inch mortar carriages, model of 1896, in service as rapidly as funds will permit. These changes consist principally of the interposition of cast-steel beams between the racer and hydraulic recoil cylinders; of the substitution of continuous grooves for the five throttling holes in these cylinders; of the addition of a brake to prevent accidental rotation of the racer, and of the addition of improved counter-recoil buffers.

Alterations.—The equipping of all 12-inch disappearing carriages, L. F., models of 1896 and 1897, with electric retracting equipment, and of the latter model with sighting platforms, 3-inch objective telescopic sights, counterbalance devices, etc., has progressed satisfactorily.

Loading platforms for subcaliber practice.—To enable subcaliber practice to be conveniently had with disappearing carriages, a platform, to be attached to the gun and extend rearward from the breech, upon which the cannoneers can stand in loading the gun, has been designed and its manufacture undertaken.

Counter-recoil throttling valve.—The increase in the velocity of counter recoil of the top carriage resulting from the increase in the weight of the counterweight in later models of disappearing carriages, made to increase their quickness of return to battery and the rate of fire, and the changes in the viscosity of the oil in the cylinders, caused by variations in its temperature, have increased the difficulty of shaping the counter-recoil buffers so as to insure their satisfactory action under all conditions. To remedy this difficulty, a valve similar to the throttling valve has been designed, which, upon trial, has been found to satisfactorily accomplish its purpose. The addition of this valve obviates the necessity of providing small hand weights.

MAINTENANCE OF THE ARMAMENT OF FORTIFICATIONS.

The system of dividing the seacoast and field armament for maintenance and improvement into districts continues to operate most satisfactorily. It was extended during the year to include telescopic sights and the different instruments for the fire-control and direction system supplied by this Department. Armament foremen and machinists are now required to familiarize themselves with the methods of cleaning and repairing these instruments, and are being furnished with special tools for the purpose.

To more closely observe the action of the material under service conditions, one of the semiannual inspections which district armament officers are required to make will hereafter be made during target practice whenever practicable.

RANGE-FINDING INSTRUMENTS.

Swasey depression position finder.—Fifty-four of these instruments were completed during the fiscal year and the remaining eighty-five since its close.

A system of direct illumination of the cross wires has been substituted for the field-of-view illumination and electric lamps added for the illumination of the four scales.

One each of the following experimental instruments for the fire-control and direction system for seacoast armament has been made during the year for the test, in accordance with designs furnished by the Chief of Artillery, viz, deflection board, range board, azimuth prediction board, wind component indicator board, board and T square for set-forward chart, prediction scale for mortars and azimuth pointer with deflection and drift scales for mortars. During the year the manufacture of 130 deflection boards, 33 plotting boards for mortars, and an experimental fire commander's plotting board was undertaken.

Azimuth instruments.—A system for illuminating the cross wires and scales has been devised and is being applied to all instruments in service.

Range-finding instruments for mobile artillery.—A battery commander's telescope, plotting board, and battery commander's ruler have been designed for use by mobile artillery; 20 telescopes and 8 plotting boards have been completed, and 64 battery commander's rulers are under manufacture.

An efficient utilization of modern field artillery requires the use of an accurate range-finding and fire-control system, for which an accurate, quickly operated, and inconspicuous range finder is a necessity. Such an instrument is now being developed.

Range finders for infantry and cavalry.—Upon the recommendation of this Department the Chief of Staff has approved the issue to each company of infantry and each troop of cavalry of one Weldon range finder and a tapeline to provide these organizations with means for measuring the relatively short ranges used by them.

STREAKED FORGINGS.

The matter of streaks in steel forgings for guns continues to be a subject of investigation. These streaks, as has been reported, are believed to indicate either a want of continuity or a lack of perfect structural homogeneity in the metal; more probably, and certainly much more frequently, the latter.

The streaks are made apparent by certain kinds of tools, or cuts and feeds, in the careful and accurate machine finishing to which gun forgings are subjected. They appear as bands on the surface of the steel, due to the fact that the band reflects light from a different angle than the general surface. They appear when viewed from a distance only.

Close and careful inspection of the surface—such, for example, as light etching or coloring with iodine facilitates—may show that the streaked appearance is due either to local variations in the physical properties or to the presence of short lines or dots indicative of minute structural unsoundness. In the case of structural unsoundness, the tensile strength of the steel across the streak is impaired, and, with the lowering of tensile strength, the development of elongation is restricted, this latter feature being incident to the former. In the direction of the streaks the strength of the metal is not affected.

The shapes and positions of streaks are modified by the forging operations and, generally speaking, tangential specimens are not likely to show their presence, though occasional oblique fracture of such a specimen in test will be determined by them. Radial specimens make their presence manifest and in test show the impairment of tensile strength which has been mentioned. These radial specimens do not, of course, represent the direction of the principal stresses in the gun, but their test shows the maximum effect on the structure of the presence of a streak.

The investigations already made have developed to a certain extent what streaks are, but have thrown very little light on the question of their source. It seems probable that any structural unsoundness must have its origin during the period of casting or of cooling the ingot. The most promising field of inquiry seems to be, therefore, the ingot itself, for the operations of forging tend to obscure or even obliterate the condition in the ingot which is developed into the streak in the finished gun forging. Investigation along these lines must, of course, take very considerable time and be expensive, but the possibility that the information gained might lead to a discovery of the means of improving structural conditions would, it is thought, justify the expenditure of the necessary time and money.

GAS-CHECK PADS.

The experimental gas-check pads now being tested to determine their fitness for service in seacoast guns embody new features in dimensions, in the material of the pad composition, and in the covering. Several pads prepared for 10-inch B. L. rifle, model of 1900, are a modified form of the service pattern, with the body reduced about 30 per cent in thickness and the exposed surface (between the split rings) proportionately more reduced in width to obviate the bulging due to melting and softening of the pad material under the

influence of heat in sustained rapid fire. These pads include, besides the ordinary material (asbestos-tallow mixture), several in which the tallow is replaced by grease or oil having a higher melting point and slight acidity. A considerable per cent of oleic acid is found to be always present in tallow and produces rust, which combined with the low melting point, about 116° F., makes tallow a relatively poor substance to use. The thinning of the pad will permit a greatly improved service with the tallow composition, but a further improvement will be obtained by using other material.

A special pad material has also been submitted which is claimed to have no melting point and to retain a requisite degree of plasticity and hardness under the heat due to all service conditions, to be a chemical compound instead of a mechanical mixture and not subject to decomposition, to be nonabsorbent of moisture, and a preservative of the canvas cover. Two pads of this material, one 12-inch and one 6-inch, will shortly be tested. The qualities described are most desirable.

Several samples of the Gerdorn pad, patent No. 732541, June 30, 1903, have been tried. The composition comprises glycerin and starch mixed with tallow or oil and a covering of wire netting. Fault was found with an earlier sample for lack of consistency in the material. A sample for 12-inch rifle, model of 1900, recently received and now under firing test promises more satisfactory results.

The present continued investigations for improvement of the gas-check pad were at first directed to providing a protection or support for the exposed surface of the thick asbestos-tallow pad to obviate its deformation under heat and cutting of the covers. The device tried included among others a complete covering of sheet copper and steel or copper cups supporting the edges. One form with light copper cups at front and rear of the exposed surface proved so efficient in ordinary firing that it was subjected to firings in 10-inch rifle, which included 30 rounds fired within thirty minutes. The fault inherent to all devices of this nature was developed in that the metal of the cups was forced outward in the repeated firing pressures and caused binding of the pad in its seat in the gun. The test showed, however, that with an equal exposed surface of a width of about three-eighths inch only in the 10-inch pad, the bulging due to heat was not objectionable, and advantage has been taken of this development in producing the later design of relatively thin pads. Asbestos wire cloth of commercial quality for steam packing was also tried as a substitute for the canvas covering. The simple asbestos wire cloth without rubber coating has given very favorable results, with absence of the cutting, scorching, or rotting to which the canvas is subject, and will be continued on trial for further observation.

POWDER.

Changes have been made in the specifications for powder for the purpose of improving ballistic results, and contracts for a large amount of powder to be made under these specifications have been entered into with the various powder makers. Effort has been particularly made to decrease the variations in results by increasing uniformity in manufacture and to eliminate, at the time of the test of the ballistic sample, powders having a critical point in their pressure curves.

In the last four or five years the requirements in regard to stability have been made somewhat more rigid, and more complete purification of the nitrocellulose is required. This has led to having frequent tests made of those powders of manufacture prior to 1900 and 1901 which have been issued to the service, and which were tested by potassium-iodide test only. Some of these are now found not to meet the requirements of the more recent tests, but it is not believed that many of them are any more unstable than they were at the time of acceptance.

Attention has been given to the absorption of moisture by nitrocellulose smokeless powder for the purpose of ascertaining the amount of moisture absorbed and the rate of absorption. For this purpose weighed samples of powder were immersed in water, being removed at intervals and weighed. Other samples were exposed to an atmosphere saturated with water vapor and also weighed to determine the per cent of increase by weight. The assumption was made in both of these cases that the gain in weight was due entirely to the addition of water, although there was undoubtedly some loss of volatile solvents at the same time. It was found that there was little difference in the rate of absorption between the powders actually immersed in water and those exposed to saturated atmosphere. It has often been assumed that all absorption of moisture by smokeless powder has been surface condensation, and that moisture does not penetrate the interior of the grains. If this were true, the absorption of water would be proportional to the surface; but these investigations indicated that this was not the case. If powders are exposed to moisture for a short period, the absorption appears to be proportional to the surface. This is explained by the fact that although the moisture enters into the powder its movement is very slow, but that it eventually penetrates and saturates the entire mass is evidenced by the tendency of the figures to approach a limit in the neighborhood of $2\frac{1}{2}$ per cent. One 15-pounder powder reached its maximum absorption of 2.52 per cent of moisture in 25 days, and another lot of 10-inch powder absorbed 2.21 per cent in 38 days and had not reached its limit. Nitroglycerin powders show much less absorptive power than the nitrocellulose powders, due probably to

the oily nature of the nitroglycerin. After all of the powders had reached their limits of saturation they were exposed to the air of the laboratory and the loss of weight noted from day to day until the weight of the powder was what it was at the beginning of the experiment. It appears that if a powder has become wet by storage in a damp magazine it would be impossible to effectually dry it out at posts by exposure to air for a short time.

From these experiments it may be concluded that nitrocellulose powders when exposed to saturated atmosphere will absorb moisture to the extent of 2 to 2½ per cent of their total weight. This absorption takes place slowly, and the time required for complete saturation is proportional to the web thickness. If a powder is not completely saturated, the time of drying will depend on the length of exposure to moist atmosphere. If completely saturated, it will vary with the web thickness of the powder and the degree of humidity of the surrounding air.

ARTILLERY PRACTICE.

Reports received during the year indicate general satisfaction with the material issued for the purpose.

Beginning with the fiscal year ending June 30, 1906, capped projectiles will be used exclusively in artillery practice, excepting 12-inch mortar projectiles, which for another year will remain uncapped. The probable effect of the increased weights of capped projectiles upon velocities and pressures, when fired with weights of charges which are now on hand at posts and which have been established to give service velocities with uncapped projectiles, led this Department to recommend that during the coming fiscal year the weights of powder charges be maintained as now required for use with uncapped projectiles. The probable effect of this course would be that maximum powder pressures will be increased approximately 2,200 pounds per square inch over those pressures which would likely result with the present service weight of projectile, and that the present service velocities will be reduced by approximately 30 feet per second for rapid-fire guns and 15 feet per second for guns of larger caliber. It is expected that one season's practice with the weights of charges above recommended will enable decision to be made as to whether or not the charges shall be increased to maintain the present standard velocity.

In continuation of its efforts to enable the striking point of one-pounder subcaliber projectiles in target practice over water to be more easily observed the Department tested recently a smoke-producing compound as a shell filler. The compound gave off about twice the amount of smoke obtained from black powder in the same volume, but the weakness of the compound caused a delay in bursting, which was the more plainly indicated by firing shell through a bursting screen

and observing the points of burst. This delay in bursting may allow the shell to emerge from the water before explosion takes place.

It is believed that this compound would not burst satisfactorily any shell except a very weak one like the maximum-capacity 1-pounder shell. The results were sufficiently promising, however, to warrant more extended trials, which are now in progress.

The reports and opinions of post ordnance officers and battery commanders concerning the action and endurance of drill primers have been of much value. While the opinions differ considerably among themselves, they enable a fairly accurate estimate to be made of the life of the drill primer body and other parts, and afford a basis of comparison of the cost of this primer and the service primer. Considering all of the reports, it is believed it may be fairly assumed that the drill primer and button wire for new model vents will stand 10 rounds as a minimum. Under this assumption the cost per thousand of the drill primers for the new model vent is about one-tenth of the cost of the combination electric-friction primer. It appears, on the whole, that the drill primer has served the purpose for which it was designed—that is to say, it permits a large number of rounds to be fired at a relatively low cost for primers. But one report adverse to the drill primer has been received, and the objections appeared in this report to refer mainly to the use of any lanyard firing primer with mortar batteries.

The greater part of the difficulty with these drill primers appears to be due to lack of experience, which will disappear after they have been longer in service. The serrated wires with the friction pellets for reloading the primers are at present issued in hermetically sealed tin cans, 100 in a can. It is possible that it might be advisable to reduce the number in each can to 50, since the number should approximate the number of rounds that will probably be fired in practice.

The Department is about to make several useful improvements in these primers which it is thought will add to their effectiveness.

A recent change in the shape of the rear end of dummy projectiles has improved their action. When they were first issued to the service the rear part of the rotating band, catching on the front end of the tray, pushed the latter to the rear, and the form of the surfaces of the front of the tray and rear side of the band prevented the possibility of sliding the projectile to the rear on the tray without at first lifting it bodily. The changes referred to have remedied the defects satisfactorily.

A new design of subcaliber tube for 15-pounders is in preparation. Experience indicates that these tubes are too light to stand satisfactorily the hard usage to which they are necessarily subjected. Since the tube is necessarily unseated and reseated at drill and at every round with .30-caliber cartridges, it is considered desirable that it

should operate easily, in order that the breech mechanism may not be damaged by its frequent operation.

Some difficulty has been had in closing breechblocks after the firing of a large number of rounds from these subcaliber tubes, due to the elongation of the cases of the tubes by the expansion of the .30-caliber rifle barrel by heat.

The addition of cleaning brushes and reamers to subcaliber outfits for 6-pounder and 15-pounder guns is contemplated.

Moving targets of a new design for light-artillery practice have been issued to several posts upon requisition. They were recommended by the field artillery board at Fort Riley, Kans., and are expected to prove more satisfactory than those which have been used to a limited extent heretofore. The target is simple, cheap in construction, and can be made at any post. It is hoped that more extended experience with them during the coming fiscal year will indicate their continued suitability.

PRIMERS.

Sometime since trouble was experienced with firing mechanisms of 6-inch guns, owing to injuries to the electric contact spring clips resulting from blow backs of primers. In addition to decided blow backs, occasionally the primer wire or the hard-rubber insulating washer surrounding it in the base of the primer case was blown out or burned.

A series of eprouvette tests was instituted with these primers and those of a pattern in which the length of the vulcanite bushing was increased to 0.24 inch and the diameter of the primer wire hole decreased to 0.08 inch. Primer after primer of each kind was fired in an eprouvette, with pressure beginning at 35,000 pounds and increasing to between 60,000 and 70,000 pounds per square inch. There were no blow backs in which the wire was driven out to the rear, but in several instances a portion of the vulcanite washer was blown or jarred away.

In firing by electricity the pressure of the gases is relied upon to force the gas-check cylinder and the wire to the rear to contact with their coned seats to check the escape of gas through the primer body. In moving over this distance, 0.2 inch, these parts under pressure of the gases must acquire considerable velocity, perhaps enough in some cases to strip the head from the wire and blow all of the interior parts to the rear, as reported. This movement necessarily follows from the friction element of this primer.

It was considered that threading the vulcanite bushing in the rear of the primer destroyed in a measure the integrity of the vulcanite. and in order to increase the effectiveness of this vulcanite bushing and

its strength to resist shearing, it has been reenforced by a brass ring screwed in the rear into the primer body. This new primer has given very satisfactory results, and is now being issued to the service.

SHRAPNEL BALLS.

The relative penetration of hard lead and soft steel shrapnel balls was determined by firing special shrapnel from 3-inch field gun. These balls were of one-half inch diameter weighing 164 and 128 grains, respectively, and their actual penetrations in white pine and seasoned spruce were determined as a function of the range measured from the point of burst. The shrapnel were supplied with sensitive point fuzes, and burst by firing them through a screen placed 10 feet in front of the muzzle of the gun.

The penetration of steel balls at 50 yards was about 72 per cent of that of the lead balls, and at 500 yards about 34 per cent.

When fired against field-gun shields placed about 50 feet from the bursting screen the steel balls showed about 68 per cent of the lead ball effect on a tempered shield and about 80 per cent on a comparatively soft shield. A few balls of each kind that struck these shields succeeded in punching holes, but the majority of them made only indentations.

CLOTH FOR POWDER BAGS.

Tests have been made of chemically treated material for powder bags to render it noncombustible. These showed that there is slightly more residue left in the chamber by the treated than by the untreated bag. The difference is slight, however, and it can be stated that this residue does not constitute a serious objection to the use of the treated material. While no reason can be seen at this time for any bad effect of this cloth on smokeless powder during storage, it is not considered safe to assume this to be a fact without actual trial.

While in land service the danger of premature ignition of service cartridges is considered remote, it is still true that the use of a non-combustible cloth for cartridge bags would give additional safety, and it is intended to continue the investigation by submitting to storage test powder bags treated with all substances now available to render them fireproof. One bag of each kind will be filled with powder, placed in a hermetically sealed case and stored for at least one year. Should such bags be adopted it is proposed to depend upon the primer to make a hole through the treated cloth in order to reach the igniter, which will be inside the bag. The primer is strong enough to do this, and it is thought that the full protection of the treated cloth can only be obtained by covering the igniter as well as the smokeless-powder charge.

ARMOR-PIERCING PROJECTILES.

Firings have been made to determine the effect of armor-piercing shell charged with high explosive and fired with oblique impact against 7-inch face-hardened plate representing the secondary armor of a modern battle ship, in accordance with a plan approved by the Board of Ordnance and Fortification.

TWELVE-INCH MORTAR LINER.

One of the 12-inch mortars at the proving ground was, owing to an error in manufacture, permitted to be lined and has since that time been utilized at the proving ground in test firings under the observation of ordnance officers in order that the Department might avail itself of this opportunity to ascertain the effect of continued firings.

The lining tube was inserted from the rear and it extends through the length of the mortar. It is secured in the breech recess by set screws to prevent turning, and it has one shoulder for support against forward movement. The shoulder is 89 inches from the muzzle, and the thickness of liner in front of shoulder is 1 inch. Protrusion of the liner at the muzzle was shown after a few rounds. After 155 rounds the protrusion is 0.6 inch, and the muzzle end has rotated 0.08 inch. There is, besides, excessive enlargement of the bore in front of the thrust shoulder at 89 inches from the muzzle. After giving what appears to be proper weight to the forces that may be ordinarily considered as acting to produce the longitudinal and torsional set observed, it is found that these are insufficient, and it is conceived that the additional stress required is produced by mandreling action of the band on the relatively thin wall of the liner. The deduction is made that the radial pressure from the band while moving rapidly forward amounts to about 40,500 pounds per square inch on the interior surface of the liner in the portion where the greatest diametrical enlargement has been produced.

BETHLEHEM STEEL WORKS.

During the fiscal year inspection work at this establishment has been under the supervision of Capt. William H. Tschappat, Ordnance Department, who is also charged with the inspection of material being procured by this Department at other places in the vicinity.

During the year the Bethlehem Steel Company was engaged in the supply of material to this Department under 20 contracts, 9 of which were completed, and also under orders for miscellaneous bars, forgings, and castings from commanding officers of arsenals and other contractors.

The principal material inspected by this office during the year included guns, cannon, carriages, shields, gun forgings, projectiles, and field artillery material.

INSPECTOR OF ORDNANCE, AKRON, OHIO.

The inspection work at Akron, Ohio, Alliance, Ohio, Cleveland, Ohio, Sharon, Pa., Pittsburg, Pa., and contiguous localities, for the year has been in charge of Capt. J. H. Rice, Ordnance Department, U. S. Army, with main office at Akron, Ohio.

The Wellman-Seaver-Morgan Company, Akron and Cleveland, Ohio.—This company is manufacturing twenty-five 6-inch disappearing carriages, L. F., model of 1903; 3 were delivered during the year, 3 will probably be delivered during the month of July, 1905, and the final delivery will probably be about July 1, 1906. The contract calls for final delivery on August 19, 1905.

The Morgan Engineering Company, Alliance, Ohio.—Beginning with the fiscal year this company had contracts for fifteen 6-inch disappearing carriages, L. F., model of 1903, and ten 5-inch barbette carriages, model of 1903. One 6-inch carriage was delivered prior to the beginning of the fiscal year, and the last of the remaining 14 on April 18, 1905. The final delivery of the 5-inch carriages was due January 10, 1905; the first carriage was delivered on May 29, 1905; the remainder are about 90 per cent completed, and final delivery will probably be about September 15, 1905. The delay has been principally caused by difficulty in obtaining acceptable steel castings. The work done by this company has been satisfactory.

The Warner & Swasey Company, Cleveland, Ohio.—During the year this company had contracts for 271 3-inch telescopic sights, model of 1904; 20 battery commander's telescopes; 42 Swasey depression position finders, type A; 117 Swasey depression position finders, type A-1; 1 25-foot horizontal base range finder; 1 8-foot horizontal base range finder; 6 sets of testing instruments for Swasey depression position finder, and 1 6-foot horizontal base range finder and protected battery commander's telescope for mobile artillery. Twenty depression position finders were delivered prior to July 1, 1904. The following instruments have been delivered during the year and on time, except for delay caused by changes in the drawings: 236 sights, 1 battery commander's telescope, 54 depression position finders, 1 6-foot range finder and protected battery commander's telescope. The remaining 35 sights will be delivered by July 15, 1905. The remaining battery commander's telescopes will probably be delivered September 12, 1905, and the remaining 85 position finders by October 1, 1905. The horizontal base range finders are awaiting the result of experiments. The testing instruments will probably be delivered September 17, 1905. The work done by this company is considered satisfactory.

The Driggs-Seabury Ordnance Corporation, Sharon, Pa.—The contracts on hand with this company during the year were for 116,000 one-pounder large capacity steel shell, one experimental

6-pounder gun and mount, 368 3-inch field limbers, model of 1902, and 234 3-inch field caissons, model of 1902. The 6-pounder mount and gun are being delayed by lack of steel castings and the date of delivery can not be safely predicted. No deliveries have been made on the 3-inch field caissons and limbers, the dates of final deliveries for which are as follows: Limbers, October 14, 1906; 164 caissons, August 6, 1906, and 70 caissons, January 1, 1907.

The Crucible Steel Company of America, Pittsburg, Pa.—During the year this company has had contracts for 98 sets of shields for 3-inch field carriage, model of 1902, and 296 sets of shields for 3-inch field caisson, model of 1902, including chest door. Three sets of caisson shields were delivered prior to July 1, 1904, and the remainder were all delivered during the fiscal year and on time. The work done was satisfactory.

This company had at the beginning of the year a contract for 1,656 6-inch and 936 5-inch A. P. shot. The contract was completed and the deliveries were made during the year.

In addition to the above, material for contractors and for other ordnance establishments was under inspection at the works of 13 different manufacturers in various localities. The principal items are as follows:

- 576,860 pounds of steel of all grades requiring test.
- 14,951 feet of steel tubing.
- 2,192 oil-can bodies for 3-inch field caisson, model of 1902.
- 10,700 pieces twist link chain.
- 604 springs.
- 21,600 pounds bronze castings.
- 110 axles for 3-inch field limbers and caissons, model of 1902.

The total value of contracts and orders under inspection during the year was \$1,592,859.33; the total value of material inspected and delivered during the year was \$621,420.40.

MIDVALE STEEL WORKS.

The work of the inspecting officer at the Midvale Steel Works includes not only the inspection of material manufactured at these works, but also that manufactured by 15 other contractors in Philadelphia and vicinity.

Owing to the shortage of officers in the Department it has been impracticable to assign an officer to this duty alone, and it was performed by Capt. H. W. Schull, Ordnance Department, U. S. Army, until August 27, 1904, and since that time by Capt. Samuel Hof, Ordnance Department, U. S. Army, in addition to their duties as assistants to the commanding officer, Frankford Arsenal.

During the year the Midvale Steel Works prosecuted work under 32 contracts with the Department and ordnance establishments, and

under 12 contracts as subcontractors. Of these, 36 contracts have been completed during the year.

The work at outside manufacturers comprised 100 contracts at 15 establishments. Of these, 74 have been completed.

The principal material inspected during the year included 414 forgings, 13 shields for gun carriages, 7,388 steel forgings for gun carriages, 327,875 pounds of steel for small arms, about 100,000 pounds of tire steel, about 10,000 pieces of flange steel, 647 steel castings, 8,386 bronze castings, 403 iron castings, 1,398 steel springs, and 2,000 medals of honor.

INSPECTOR OF ORDNANCE, BALTIMORE.

Capt. Lawson M. Fuller, Ordnance Department, performed the duties of inspector in Baltimore in addition to his duties in the office of the Chief of Ordnance.

Detrick & Harvey Machine Company.—The last of fifteen 6-inch disappearing gun carriages, L. F., model of 1903, under contract dated August 19, 1903, was delivered on March 25, 1905. Almost all the component parts of these fifteen carriages were done by jig, and, in addition, all circular parts were ground so that the resulting carriages are believed to be exceptionally well made.

On February 6, 1905, a second contract was made with this company for furnishing ten carriages of the same design. All gun and common iron castings have been delivered and the smaller parts finished. Forty-three heats were required for the production of the castings required. One hundred and eighty-five test specimens were pulled, each heat averaging 31,699 pounds per square inch. Of the parts cast, three racers, two base rings, four top carriages, and many minor parts were rejected due to faulty material.

The forgings and about seven-eighths of the steel castings have been received, but many of the latter parts have been returned to the makers on account of defects in the material. Of the larger parts, eight racers and five base rings are machined.

Ellicott Machine Company.—On January 25, 1905, a contract was made with this company for 500 cast-iron caps for 5-inch projectiles, and on April 15, 1905, another contract was made for 1,000 cast-iron caps for 8, 10, and 12 inch projectiles. The caps under the above contracts are being made by the American and British Manufacturing Company, of Bridgeport, Conn., as subcontractor.

THE UNITED STATES RAPID-FIRE GUN AND POWER COMPANY; AMERICAN AND BRITISH MANUFACTURING COMPANY; SCOVILL MANUFACTURING COMPANY.

Of the 8,000 rounds of 15-pounder steel-shell ammunition remaining to be delivered by the United States Rapid-Fire Gun and Power Company at the beginning of the fiscal year, one lot of 1,000 rounds

has been delivered. Several other lots presented failed in the ballistic test, and the probability of the company's being able to supply the remaining rounds seems extremely small. During the year this company completed the conversion of the 20 3-inch wrought-iron muzzle-loading guns to breech-loading saluting guns, contracted for the preceding year, and an additional order for 25 more guns of the same type. They have also under manufacture and practically completed one 6-pounder semiautomatic gun and mount.

During the year the American and British Manufacturing Company have done work under 15 contracts with the Department, and two orders from ordnance establishments. These contracts and orders covered the following material, viz, 34 3-inch field guns, model of 1902; the conversion of 135 3-inch wrought-iron muzzle-loading guns to breech-loading saluting guns; 40 3-inch field carriages, model of 1902; projectiles for small cannon, and hubs for wheels of field-gun carriages. With the exception of 15-pounder steel shell, all deliveries have been satisfactory. A number of lots of these shell failed in the ballistic test, but the company appear now to have overcome this difficulty and it is expected will speedily complete the deliveries under this contract. In addition to the contracts and orders mentioned, they have also made 778 hubs for wheels for field carriages for the Archibald Wheel Company, and have just received a contract for 70 3-inch field caissons, model of 1902, and 20 more 3-inch field carriages.

The Scovill Manufacturing Company received a contract in February for 25,000 1-pounder steel shell, to be delivered in September, 1905. The work is progressing favorably, and no delay in delivery is anticipated.

This work at the establishments mentioned, and also the inspection of various small orders for ordnance material at the Bridgeport Forge Company, the Bridgeport Brass Company, the Pratt & Whitney Company, Hartford, Conn., and the Coe Brass Company, Ansonia, Conn., given by the commanding officers of arsenals, has been under the charge of Capt. W. S. Peirce. Ordnance Department, during the past year.

THE BUILDERS IRON FOUNDRY, PROVIDENCE, R. I.

The work of this establishment was inspected during the year by Lieut. Walter G. Penfield, Ordnance Department. The 12 carriages referred to in my last report as remaining uncompleted were shipped during the year, and the contract was completed on May 2, 1905.

ARCHIBALD WHEEL COMPANY, LAWRENCE, MASS.

This company is engaged in the manufacture of wheels for mobile artillery. During the present fiscal year 878 wheels were completed and inspected. Maj. Frank Baker, Ordnance Department, was the

inspector at these works until May 1, 1905, upon which date he was relieved by Lieut. Walter G. Penfield, Ordnance Department.

COWDREY MACHINE WORKS, FITCHBURG, MASS.

This company has been engaged during the present fiscal year in manufacturing cast-iron projectiles under three different contracts with this Department. Maj. Frank Baker, Ordnance Department, was inspector at these works until May 1, 1905, when he was relieved by Lieut. Walter G. Penfield, Ordnance Department.

SANDY HOOK PROVING GROUND.

The proving ground was commanded during the year by Col. Charles S. Smith, Ordnance Department, U. S. Army, who is also president of the Ordnance Board; president of Board for Testing Rifled Cannon, and armament officer of the Sandy Hook armament district.

Firings for experimental and proof purposes have been conducted daily, weather permitting.

The following material received at the proving ground has been subjected to ballistic test:

- 28 lots of projectiles.
- 10 lots of shrapnel.
- 97 guns.
- 80 lots of powder.
- 1 lot of fixed ammunition.

The firings during the year have involved the expenditure of 92,727 pounds of powder, 3,399 rounds of fixed ammunition, and 19,523 pounds of high explosives, a total of 6,329 rounds having been fired, while 18 fragmentation tests were made.

The railroad, by means of which the proving ground is connected with all points outside, has proved a source of convenience and economy in the transportation of men and materials. The total amount of freight shipped over this railroad during the year amounted to 36,636,453 pounds, requiring a total car movement of 908 cars. The total number of passengers carried during the year was 125,200.

Under the authority contained in the fortifications act approved March 3, 1905, it is proposed to straighten about 1.6 miles of the railroad, by relaying the track from a point near the proof battery to what is known as the "Y," which will give a straight track, outside of the zone of fire from the proof battery to the trestle, a distance of about 5 miles. This work was undertaken in the latter part of June, and will be completed within three months.

The new railroad trestle referred to in last year's report has been completed. The contract provided for about 4,460 feet of the trestle

proper and an approach at the Sandy Hook end of 850 feet, and a siding at the Highland Beach end of about 400 feet in effective length. That part of the old trestle at the Highland Beach end to the point where the new trestle crosses it is also utilized as a second siding, which is about 540 feet in length. That part of the old trestle from the Sandy Hook end to near the point where it crosses the old trestle will be used by the Engineer Department as a foundation in strengthening the breakwater along this neck of land.

A Fairbanks railway scale has been installed north of the machine shop and on the railroad track along the north side of the new storehouse. A small house was erected over the scale arm, in order to protect the scale and the operator from the weather. This scale is of sufficient capacity to permit the weighing of all shipments of ordnance material.

New construction.—The addition to the wing of the brick house, for accommodation of officers temporarily at the proving ground, authorized by the fortifications act approved June 6, 1902, has been practically completed during the year.

Plans and specifications for the construction of the barracks for enlisted men, authorized by the fortifications act approved June 6, 1902, and for the construction of a brick building for housing three locomotives and one locomotive crane, authorized by the sundry civil act approved April 28, 1904, were prepared and bids for the work of erecting these buildings invited. All of the bids received and opened were greatly in excess of the funds appropriated. An additional appropriation will be asked for in the case of the barracks, and the plans modified, in order to reduce the cost. The details of the locomotive house will be modified in order to bring the cost of the building within the amount appropriated.

Four bombproofs, for the protection of observers at the targets and to provide facilities for observing the bursting point of shrapnel and high explosive shell, authorized by the fortifications act approved April 21, 1904, were built during the year. These stations, of concrete 8 by 10 by 7 feet 6 inches, protected by walls on the sides toward the line of fire, and proof battery 18 inches thick, and 8 feet of sand provide safe observation stations. The observation slots are three-sixteenths inch wide, with edges reenforced by angle iron, and allow a full view of all the ground surrounding the target and the space between targets.

The contract for the construction of the observation range and plotting tower, authorized by the fortifications act approved April 21, 1904, has been let, and the tower will be completed within a few months. The structure will consist of steel framework, resting on a concrete base, and supporting the instrument room, where the Swasey depression position finder, type A, will be installed.

Plans and specifications for the construction of one set of quarters for the locomotive engineer, authorized by the sundry civil act approved March 3, 1905, have been prepared, and bids will be invited for the erection of the building in the near future.

The proof battery has been enlarged, by adding several emplacements between those already constructed, to accommodate the number of carriages which the increased amount of firing requires should be mounted at the same time. The method of taking velocities has been greatly improved. Three light railroad tracks, running parallel to the battery, have been constructed, on which run cars carrying the velocity frames. These cars are accurately located by means of monuments in the line of the gun which is to be used. This arrangement fixes the distance between the screens and from the muzzle of the gun to the first screen, thus avoiding any possibility of error from this source. Six chronographs, instead of four, are now mounted in the instrument room, in groups of three, so that two sets of velocities may be taken at the same time. The entire arrangement of the switchboards has been improved, and the wiring to the front has been placed in underground conduits.

Twelve 3-inch well points were installed, with a view to furnishing an increased water supply for fire protection and emergency uses. The site selected was a sandy knoll in front of the office building, in the angle between the roads leading from the proof battery to the office building and the road from the brick house to the office building. This new group of well points is connected by a 5-inch main to the old 5-inch main leading from the well-point group at the explosion chamber to the pump in the engine room.

Survey of Sandy Hook.—For the purpose of making a new and accurate map of the proving ground a survey of the northern portion of Sandy Hook has been made, and the work of making the map is in progress and will be completed at an early date.

Shops.—The shops have been fully occupied during the year with the experimental work of the proving ground, together with work in connection with the armament installed in the Sandy Hook and in the central armament districts. The capacity of the power plant has been increased to meet the increasing needs of the establishment, and a condenser has been installed, which it is expected will increase the efficiency of the plant and thus result in a saving in the cost of fuel.

INSTRUCTION OF OFFICERS.

The class during the year consisted of six officers, and practical instruction was given in chemistry of powders and explosives, applied electricity, and metal-working machines. The work accomplished in the different departments has grown steadily since this instruction

was inaugurated, and the student officers continue to show a commendable interest.

Chemical laboratory work.—Practical instruction was prescribed for the first time and satisfactory progress was made for the first year. Each officer was required, among other things, to make at least one complete chemical analysis of samples of black and smokeless powder; to conduct all the tests prescribed for the acceptance of nitrocellulose and nitrocellulose powders; to manufacture, in small quantities, nitrocellulose and one other nitro compound; to determine the composition of the gas produced by the explosion of nitrocellulose, and to make the standard physical measurements of powder constants. Through the courtesy of Mr. H. F. Brown, International Smokeless Powder and Chemical Company, the officers were given an opportunity to witness the manufacture, at Parlin, N. J., of smokeless powder on a large scale.

Machine-shop work.—The programme for practical instruction in this Department consisted of twenty-one graded exercises on the lathe, ten on the universal milling machine, and six on the planer and shaper. A photograph, accompanying the report of the commanding officer of the proving ground, shows the pieces actually machined by the officers. The quality of their work was of a high order, and would justify the rating of "Good machinists." Each officer who takes this course is equipped (1) in the capacity of inspector, to distinguish between good and bad machine work, and to determine the cause of defects; (2) to fix the order of operations, and the machine to be used in making, in the most economical way, any machine or piece of apparatus that he may be designing. These are the two principal objects of the instruction. For the ensuing year the schedule will include practical instruction in foundry and blacksmith work, polishing and electro-plating of metal.

Department of electricity.—All student officers took an active interest in the work of this department. A system of night lectures was inaugurated, and the greater part of the work, both practical and theoretical, was done at night, since the officers were usually fully occupied with regular proof work during the day.

ROCK ISLAND ARSENAL.

This arsenal was commanded during the year by Lieut. Col. Stanhope E. Blunt, Ordnance Department, U. S. Army.

Artillery store shed.—The 3.2-inch field artillery material in service, now being replaced with the 3-inch, should be stored as a reserve supply. As no building is available for this purpose, a design has been prepared and an estimate for its construction submitted.

Hospital.—The present building used as a hospital is a wooden structure, temporarily erected more than forty years ago. It is now,

and for some years past has been, in a deplorable condition, and is totally unfit for housing the sick. Estimates for several years past have been submitted for the erection of a new building, but as the project has failed to secure the approval of Congress, and as the necessity for some action regarding the hospital building has become so great, it is recommended that those soldiers who require hospital treatment be sent for that purpose to one of the hospitals in the adjacent cities, and that for emergency treatment a smaller structure be provided that will afford accommodations for the sergeant of the hospital corps and contain also rooms for the dispensary and surgeon's office. Estimate of the cost of such a building is submitted.

Stable.—Accommodations for public horses and for private horses of officers allowed by law were provided in separate buildings, remote from each other, until one was destroyed by fire on October 11 last. The remaining building is so old and in such wretched condition as to be beyond repair, and is of insufficient capacity. It is recommended a single building, properly located, be constructed. An estimate for such a building is submitted.

Quartermaster-sergeant's quarters.—There are now no quarters at this arsenal for the post quartermaster-sergeant, who has to live in a neighboring city and be paid commutation of quarters. This method, besides involving unnecessary expense, removes the sergeant from the arsenal at all except regular work hours, and his services are not available if an emergency requiring immediate shipment of stores should arise. An estimate for quarters for this noncommissioned officer is submitted.

Storehouse.—The storehouse, to replace the one that was destroyed by fire in February, 1903, was completed during the year. It cost \$147,520. It is a building of modern construction, with fireproof floors and partitions, and is well adapted for its purpose.

Officers' quarters.—The set of officers' quarters for which an appropriation was made in the sundry civil bill approved April 28, 1904, was completed during the year, and is occupied. Quarters for additional officers will be needed in the future, but estimate is not now submitted for them.

Rock Island wagon bridge.—The bridge from the arsenal to the city of Rock Island, with viaduct extending over the railroad tracks in that city, was constructed a number of years ago when the amount of traffic and the weight of its separate units were much less than at the present time. Under present conditions the bridge is not only of insufficient strength, but of inadequate width for the traffic now using it. As a matter of precaution all teams are now required to traverse the bridge at a walk, delaying and blocking traffic, especially at the busier hours of the day. The bridge should be reconstructed by additions to the present piers and with a new superstructure. A slight

increase in height at the viaduct and change of a few feet of the center line of the bridge, to remove a sharp curve, are also desirable. Estimate for the work would be submitted were it not for the stringent necessity for keeping those for the Department at a low figure.

Water supply and fire protection.—The water supply of the arsenal is obtained by pumping from the Mississippi River to a tank near the shops, and fire protection is secured by water mains, which are of ample size, and by hydrants sufficient in number and properly located, but experience has shown during two disastrous fires in recent years that the tank is not of sufficient height, if water is taken directly from it, nor are the pumps of adequate capacity to sustain in the mains a sufficient pressure for that purpose. There are no steam fire engines in any of the immediate adjacent cities and but one at the arsenal. For a small fire this single engine might prove ample, but with a fire of any magnitude many additional streams which, with the pressure now secured, can not be provided by the hydrants are necessary. As the property in buildings and ordnance stores is of great value, it should not be left in such jeopardy. A more adequate system of water supply and fire protection should be established. This could best be obtained by installing two pumps having a capacity of about 1,400 gallons per minute, each of which would be operated by a 75-horsepower motor. Such a new plant could be installed in the present pump house by an extension of only 28 feet, and would be operated during working hours at only sufficient pressure to deliver water for manufacturing purposes on the second floors of the shops; but in case of an emergency by fire the pressure could be increased so as to obtain from hose directly attached to hydrants as effective a water stream as that now obtained from the arsenal single engine. An estimate for such a plant is submitted.

Water power.—To the 100 electric motors previously installed in the shops, one of 20 horsepower, one of 30 horsepower, and two of 40 horsepower have been added during the year, bringing the total up to 2,494 horsepower for all the shop motors.

For a number of weeks during each of the past winters ice gorges have formed in the Mississippi River either below the island, backing the water up in the tailrace, thus reducing the head, or in the pool above, cutting off the flow of water to the wheels, but in both cases greatly reducing for a few days or even entirely stopping the arsenal power plant. With the great development of the arsenal in recent years and the certainty of extended operations during war, it is essential that the first and most important requisite, ample power, should be available without the possibility of interruption. Without an auxiliary steam plant the arsenal will probably during working hours, during certain portions of every year, be compelled to rely upon

private establishments for a portion of its power. It is probable, however, that during other hours sufficient electric power in excess of the needs of the arsenal may be rented, under the authority recently granted by Congress, to offset the cost of the power the arsenal may be required to purchase.

Additional machinery in the shops at the arsenal and armory rows.—One hundred and thirty-six machines of various kinds have been added during the year, most of them being procured for completing the plant of the principal machine and gun carriage shop, and also for the final equipment of the armory shops for the manufacture of the United States magazine rifle, model of 1903.

Arsenal shops.—For convenient and economical prosecution of work, these shops are divided into the machine, foundry, and forge shops; the polishing, plating, equipment, and tin shops; the carpenter and paint shops, and the harness shop.

In the first group of shops the principal work has been in connection with manufacture of the vehicles of the 3-inch field artillery material; in addition, five 6-inch barbette carriages, model of 1900, and twenty-five armament chests for 7-inch siege howitzer have been completed, and considerable progress made on pilot carriages for the 4.7-inch siege gun, model of 1904, the 3.8-inch field gun, model of 1905, and the 2.38-inch field gun, model of 1905. The siege carriage is practically completed; the carriages and limbers for the other guns are well advanced. In addition, work has also been commenced upon 30 wheeled mounts, model of 1905, for Vickers, Sons & Maxim automatic machine gun, caliber .30.

The greater part of the force in these shops has been employed upon the 3-inch field artillery material, model of 1902, of which 100 carriages were finished by the close of the fiscal year and 18 others so far advanced that completion was to be reached before the end of July. Of the limbers 390 were finished during the fiscal year and 24 others are now nearly completed. Of the caissons, 150 were finished July 1, 1905, and 162 are so far advanced that their completion is anticipated by November 1, 1905. The store-wagon limbers, forge limbers, store wagons, and battery wagons for 52 batteries are either finished or well advanced toward completion.

The construction of 48 carriages, 224 limbers, 69 caissons, and store-wagon limbers, forge limbers, store wagons, and battery wagons for 17 batteries was commenced in March, 1905, the greater portion of which will be completed by the close of the present calendar year and the balance, it is expected, will be finished by March, 1906.

During the earlier months of the fiscal year nearly 450 machinists were employed on this work, exclusive of those in the armory shops, in connection with manufacture of the new magazine rifle,

and until April a night shift was also operated. After that date the night shift was discontinued, as the work was so far advanced that all necessary output could be obtained with a single shift.

In the foundry the work has been of the usual nature, the only novelty being the introduction of a number of molding presses by which the labor cost of work formerly done by hand has been reduced about 18 per cent and the loss from defective castings also reduced to nearly the same extent.

During the year the polishing and plating shops which formerly had been under the supervision of separate foremen were combined with the equipment shop and placed under the foreman of the latter department. This concentration of work under a single head has been found decidedly advantageous. To the equipment shop during the year has been transferred a considerable amount of the artillery carriage and of the pack outfit work formerly executed in the machine shop, permitting its prosecution on a piece system at considerably less cost than when formerly done by machinists and with equal accuracy and expedition. In addition to the regular output a number of new designs have been completed, of which the principal are the insignia for General Staff, the kits of tools for repair of parts of cartridge belts, new marksmen's pins, class A, stencils of new pattern for canteens, and badges for field artillery practice.

Besides the usual output of meat cans, cups, etc., of standard pattern and the tinning of many thousand knives, forks, and spoons, the shop has turned out 400 experimental canteens of copper, 20,000 aluminum meat cans, and 5,000 aluminum cups with iron handles, which have all been issued for trial. The iron handle was adopted for the aluminum cups in consequence of the receipt of complaints that the aluminum retained heat to such an extent as to interfere with holding the cup in the hand. A number of experiments were made with the object of overcoming this defect, resulting finally in the adoption of an iron handle with a piece of hard fiber interposed at the points where the handle is fastened to the cup.

Changes in the carpenter shop from day to piece work have been effected during the year until practically all standard articles of manufacture are now made under the latter system. A decreased and definite cost of labor is thus secured, and, incidentally, additional earnings are made by the workmen, due to their special efforts. The stirrup-bending machine, formerly operated entirely by hand, is now run by power, and made practically automatic; it produces double the former output in the same period with only two-thirds of the previous attendance.

The manufactures in the harness shop have been about 20 per cent greater than during the previous year, the principal stores manufactured including 614 sets of artillery harness for two wheel horses,

1,226 sets for two lead horses, 1,146 pack saddles for 75 mm. mountain gun, 350 pack saddles for caliber .30 automatic machine gun, and about 12,000 sets of standard horse equipments, 40,000 sets of cavalry equipments, and 80,000 sets of infantry equipments.

Armory shops.—Work in the armory shops preliminary to manufacture of the United States magazine rifle, model of 1903, was initiated in May, 1904, with the transfer from the Springfield Armory of a number of expert mechanics to act as foremen, inspectors, and leading men; and, following their arrival, other employees were secured from the neighboring cities, and an organization for the shops established and perfected, by which an output of the component parts for 125 rifles per day had been attained early in January, 1905. Since then changes in designs of the bayonet and sight compelled suspension of work upon those parts and upon others depending upon them, and of the assembling of completed arms. Work was, however, continued on the other components not affected by the pending changes. The parts of 18,000 rifles were entirely finished, and there were in addition in progress in the various stages of operation components equivalent to about 4,000 rifles at the close of the fiscal year.

The task of putting into complete operation this small-arms plant has thus been successfully accomplished. It has required the cooperation and united efforts of this Office, of the officers of the Springfield Armory, and of the officers of the Rock Island Arsenal. The Department has been fortunate in having in the commanding officers of these two establishments men thoroughly conversant with the manufacture of small arms. The commanding officer of the Springfield Armory has exhibited a spirit of comprehension of the needs of the Department at large which has led him to contribute cheerfully to the loss from his own armory of some of its most expert operatives in order to meet the needs of the young establishment of which his own has been in a sense the parent. It is owing to its fortunate possession of skillful and educated officers, and of experienced and well-trained foremen and operatives, that the Department has been able to put the new plant into operation with a smoothness and a lack of hitches and of extraordinary expenses which are believed to be rare in the establishment of such extensive industries. The judgment of the service is invited upon the product.

Proving ground.—An observation tower and an additional safety traverse have been constructed at the proving ground, permitting the use of a range of approximately 6,500 yards. The range has been used for proof firing 3-inch field guns at maximum elevation, and also the carriages manufactured at this arsenal. During the year a total of 475 rounds have been fired and forty-five 3-inch field guns, model of 1902, and thirty-six 3-inch field carriages have been proof fired.

The equipment of the proving ground has been supplemented by the purchase of a Tabor steam indicator with Houghtaling reducing motion. A Sebert velocimeter has been ordered and will shortly be delivered. When this instrument is received the proving ground will be equipped with all the necessary conveniences and instruments for experimental and proof work with mobile artillery.

SPRINGFIELD ARMORY.

The armory has been commanded during the year by Col. Frank H. Phipps, Ordnance Department, U. S. Army.

All the buildings and grounds have received the needed attention to keep them in good order. A new pipe has been connected with the city main to augment the supply of water to the elevator in the main arsenal building, heretofore insufficient. A substantial brick oilhouse for the storage of oil has been erected. A space has been leveled and the foundations laid for a target house for targeting each rifle manufactured.

Manufactures.—The following principal arms were manufactured during the year: 43,905 magazine rifles, caliber .30, model of 1903; 377 officers' sabers; 2,905 hospital corps knives; component and spare parts for the model of 1903 rifle, and many appendages and miscellaneous articles.

There were repaired during the year 28,992 magazine rifles, caliber .30, models of 1896 and 1898, and 14,069 bayonet scabbards, together with officers' sabers, saber scabbards, cadet swords, etc.

The following stores were repaired by or purchased from manufacturers: 2,279 Colt's revolvers, caliber .38, model of 1894, repaired; 158 Colt's revolvers, caliber .38, model of 1901, repaired; 50 Colt's revolvers, caliber .45, "new service," purchased; 19 Winchester repeating shotguns, model of 1897, purchased; 5 self-loading magazine rifles from the Dansk Reykl-riffel Syndikat, purchased.

Machines.—During the year 32 machines of various kinds were purchased or fabricated and installed, and an automatic telephone system introduced.

Magazine rifle, model of 1903.—At the beginning of the past fiscal year, 30,000 United States magazine rifles, caliber .30, model of 1903, had been manufactured and packed ready for shipment, and 300 were being completed daily. In August, 1904, as a result of the new Infantry Drill Regulations, prescribing that the piece should be habitually carried loaded and locked for safety, it was found necessary to change the form of the cocking piece and safety lock. This required the manufacture of new cocking pieces, firing pins, sleeves, and safety locks, and the introduction and manufacture of the safety lock spring and spindle. To supply these parts in sufficient

quantities for the daily output of guns, and to replace corresponding parts in the guns previously assembled, it was necessary to resort to night work.

A change in the follower also was ordered in October, 1904.

By November, 1904, the output of finished rifles had been increased to 400 a day, and in addition new parts fabricated for the guns first assembled. At the beginning of January there were 74,000 rifles completed and packed. On January 11, in compliance with instructions, work was suspended on the rod bayonet, rod-bayonet stud, rod-bayonet catch, rod-bayonet catch spring, upper band, stacking swivel and screw; and as the adoption of a different form of bayonet, then being considered, would modify at least the position of the front-sight stud, and the form of sight then in use would not permit of adjustment for targeting of the rifles, work was also suspended on the front sight and front-sight stud. In April, 1905, instructions were given to cease all work on the rear sight. Of the parts upon which work has been suspended, definite instructions as to the bayonet and front band have been given, and the gauges and fixtures for these parts are being prepared as quickly as possible. The daily output of the parts not modified has been maintained at 400 per day, and there are enough of these parts for 140,000 rifles, including the parts in the 74,000 assembled rifles on hand.

Experimental firings.—It is found in experimental firings with United States magazine rifles, caliber .30, model of 1903, that after from 1,200 to 1,500 rounds the accuracy decreases. While this decrease is not sufficient to impair the efficiency of the rifle as a service weapon, it amounts to about 10 per cent, and increases until at 3,500 rounds the mean absolute deviation at 500 and 1,000 yards is twice that obtained with a barrel when new.

Extensive investigations have been made extending over the past year to determine the possibility of increasing the life of the barrel of this rifle, including tests to determine the effect upon accuracy of the deposit made by the bullet during its passage through the bore and the effect upon the life of the barrel caused by changes in the form and number of grooves of the rifling and in the composition and treatment of the barrel steel.

Manufacturers and dealers in steel were invited to submit samples. Five samples of barrel steel used by foreign countries were received, and these, with samples submitted by the best-known manufacturers in this country, were subjected to a comparative test with samples prepared at the armory. The results showed clearly that the loss in efficiency of the barrel is due almost entirely to erosion occurring at and directly in front of the seat of the bullet, and is practically independent of the form of rifling used, of the wear of the lands, and of the slight metallic deposit.

Investigations now in progress have for their object the reduction of this erosion, but the principal difficulty experienced is that the steels that resist the erosive action of the powder gases are, as a general rule, exceedingly difficult to machine. There is every reason to believe a more satisfactory steel will be found than that now used in the manufacture of this rifle.

Fuel-oil plant.—Fuel oil having proved so satisfactory as a fuel in place of anthracite coal in the hill shops, a fuel-oil plant has been installed at the water-shops to replace the use of gasoline for many of the furnaces in the forge shop. The plant has been running for about two months in a most satisfactory manner, and has resulted in a saving of \$288 per week. Since the installation of the fuel-oil plant a new feed-water heater, which heats the feed water for the boilers from the compressor exhaust, has been installed.

FRANKFORD ARSENAL.

This arsenal has been commanded during the year by Lieut. Col. Frank Heath, Ordnance Department, U. S. Army, who is also a member of the Board for Testing Rifled Cannon. Its operations have included the manufacture of ammunition of all classes for small arms, of metallic cartridge cases for field, siege, and seacoast guns up to 6-inch caliber, shrapnel for the field artillery, percussion, combination time and percussion, and detonating fuzes, electric and friction primers, sights for the field artillery, ballistic and plotting boards, and other instruments for the control of the fire of seacoast artillery, star gauges and other measuring instruments required for inspection purposes.

During the year the following buildings have been completed: Double-acting-press room and metal shed; storehouse, small-arms ammunition plant; carpenter shop. The first two complete the system of buildings comprising the small-arms ammunition plant.

Fuze and primer department.—In connection with the routine work of this department important experiments have been conducted, having for their object the development and completion of successful working designs of the 21-second combination fuze for mobile artillery, the centrifugal percussion fuze for all calibers of projectile above the 2.24 inch, and detonating fuzes for all classes of field, siege, and seacoast projectiles to be charged with the service high explosive. The result of the year's work has, on the whole, been encouraging, and it is believed that the most important difficulties have in all cases been overcome.

An object sought in the investigation has been a time fuze that would enable the maximum effect of shrapnel fire to be developed at all ranges with the new field gun.

Other elements in addition to the time train that require careful adjustment are the strength of the concussion or igniting primer, the reenforcing pellets, the ventage, and the adhesion of the cloth disks separating the time-train disks from each other and from the fuze body, all of which have received careful and successful study.

The principal modification in the design of the centrifugal percussion fuze has been the application of a device for insuring positive rotation of the plunger. This fuze, as now manufactured, embodies in a remarkable degree the elements that insure safety in handling and transportation and certainty of action.

Experiments with detonating fuzes have been conducted during the year, resulting in the approval for manufacture of three forms of these fuzes for major, medium, and minor caliber projectiles, respectively.

Shrapnel plant.—During the past year the shrapnel shop has been removed into the new two-story brick building erected as a shrapnel factory for all calibers, and a large part of the equipment necessary for shrapnel manufacture has been installed. With the machinery now on hand and the new machines ordered this plant will be admirably adapted to its purpose, and will be able to maintain a product of 200 3-inch shrapnel per day, and 25 5-inch, or 20 6-inch, or 15 7-inch shrapnel per day, or a corresponding number of the intermediate calibers for the new material. Of course by reducing the number of 3-inch shrapnel per day the number of other calibers per day could be correspondingly increased.

A shrapnel of new design has been developed at this arsenal during the year. This design was prepared with a view to overcoming the defects and weaknesses inherent in the hexagonal shrapnel and the necessity for using the expensive steel-jacketed lead ball. The case is pressed or forged from a high grade of steel, and is designed to have sufficient strength to meet with a factor of safety all the conditions imposed by the use of the base charge. It resists deformation in the gun on discharge, and it remains intact at the point of burst. It enables the use of a cheap lead ball, obviating the necessity for the expensive steel jacket, and by the use of a stiff smoke-producing matrix prevents upsetting of the lead balls and makes the point of burst of the shrapnel visible at extreme ranges.

Much attention has been given during the year to the application of automatic machinery to the various operations on fuzes and shrapnel, and a number of interesting machines of this class have been installed and are in successful operation.

Department of sights, instruments for fire control, etc.—During the year this department has been busily engaged, working two shifts of eight hours each, in the manufacture of sights for the 3-inch field

carriages, the application of illuminating devices to azimuth instruments, range finders, etc., and in the fabrication of Whistler-Hearn plotting boards. The plant and system of inspection of the output, which was in an entirely undeveloped condition at the beginning of the year, is now in a high state of efficiency.

Small-arms cartridge department.—The total number of small-arms cartridges manufactured during the fiscal year was 63,043,411, a greater number than in any previous year at this arsenal. Since January 1 the daily output has been 240,000.

An extension of the loading room is now in progress. Its completion will give much relief in the most congested portion of the plant, and will permit of a separation of the machines, which will materially reduce the danger to the operatives in this room.

WATERVLIET ARSENAL.

This arsenal was commanded by Lieut. Col. D. M. Taylor, Ordnance Department, U. S. Army, from the beginning of the year until February 9, when he was obliged to relinquish command on account of sickness. Maj. L. L. Bruff, Ordnance Department, U. S. Army, was in command from February 9 until May 1, and Maj. Ira MacNutt, Ordnance Department, U. S. Army, from May 1 until the end of the fiscal year. Major MacNutt is also a member of the Board for Testing Rifled Cannon.

This is the Army Gun Factory and it supplies a large percentage of the cannon of all calibers used in the military service, together with the spare parts, tools, etc., which are required at seacoast fortifications. There were employed in June last 496 workmen, and the expenditures for the year were \$926,910.59.

The manufactures at this arsenal during the fiscal year consisted of 10-inch and 12-inch seacoast rifles, 12-inch mortars, 7-inch and 8-inch navy rifles, 5-inch and 6-inch rapid-fire guns, and 3-inch field guns. In addition to these, the following experimental guns were completed: One 6-inch rapid-fire wire-wrapped gun, one 4.7-inch siege howitzer, and one 3-inch (15-pounder) semiautomatic rapid-fire gun and mount.

It is worthy of note that the experimental 6-inch wire-wrapped gun, above referred to, is perhaps the first wire-wrapped gun ever constructed in this country the tension on the wire of which is known with absolute certainty throughout its entire length. The wire-wrapping machine which was purchased for doing this work was designed to regulate the tension on the wire automatically between certain fixed limits, but it failed to do this in a satisfactory manner, and it was necessary to practically rebuild the machine before satisfactory results were obtained. A dynamometer was applied to it and hand

regulation resorted to instead of the automatic regulation, which was found to be unsatisfactory. As a result it was possible to regulate the tension on the wire to within 1 or 2 per cent of any prescribed amount.

The application of individual motors to the gun lathes in the north wing of the seacoast gun shop has been completed, and the results have more than fulfilled expectations. The output of the lathes has been increased, the control has been made more simple, and the increase in efficiency has been considerable.

A motor generator set of 160-kilowatt capacity has been installed and the power for running the machines of the seacoast gun shop is now supplied by the Hudson River Electric Company. The service has thus far been very satisfactory. The extension of electric transmission of power throughout the gun shop has progressed satisfactorily and will be completed during the coming year.

The 130-ton crane in the south wing of the gun shop has been rebuilt and converted from a 1-motor crane to a 4-motor crane and the runway replaced by a heavier and more substantial construction. This crane can now be regarded as a modern high-speed crane. Steps have been taken looking to the rebuilding of the two 80-ton cranes in the north wing of the gun shop, and it is expected that this work will be completed during the coming year.

A local telephone exchange with 29 instruments has been installed and has greatly facilitated the transaction of the business of the arsenal. It also forms a very important addition to the fire-alarm system of the post.

A feed-water heater has been installed for the purpose of keeping the water in the fire engine hot at all times, and the number of fire plugs with hose attached has been increased by six. These new fire plugs are situated in the field and siege gun shop where the protection against fire was regarded as inadequate.

The output of the gun shop during the past year has been equivalent to:

10-inch rifle.....	1
6-inch rapid-fire guns.....	59
5-inch rapid-fire guns.....	4
4.7-inch siege rifle.....	1
3-inch 75 mm. mountain guns.....	35
8-inch rifles (Navy).....	10
7-inch rifles (Navy).....	2
3-inch rapid-fire gun (semiautomatic).....	1
8-inch field guns.....	80

In addition considerable work has been done on barbette carriages for 5-inch and 6-inch rapid-fire guns, and large quantities of spare parts have been manufactured.

WATERTOWN ARSENAL.

This arsenal was commanded during the fiscal year by Maj. I. MacNutt, Ordnance Department, U. S. Army, who is also a member of the Board for Testing Rifled Cannon, and Maj. Frank E. Hobbs, Ordnance Department, U. S. Army, the latter having assumed command on April 27, 1905.

The principal operations at this arsenal during the year have comprised the manufacture and issue of gun carriages of various calibers, parts for the modification of carriages, and the usual large amount of stores for the Army, especially those articles connected with the armament of fortifications. The plant has been operated to its full capacity except for short intervals in the foundry and smith shop.

The following gun carriages have been completed during the year: Three 12-inch disappearing carriages, L. F., model of 1901; seven 10-inch disappearing carriages, L. F., model of 1901; twelve 6-inch barbette carriages, model of 1900; one 6-inch disappearing carriage, L. F., model of 1903; and one 12-inch mortar carriage, model of 1896, modified.

Work is in progress on five 10-inch disappearing carriages, L. F., model of 1901; three 6-inch barbette carriages, model of 1900; fourteen 6-inch disappearing carriages, L. F., model of 1903; and forty-two 75 mm. Vickers-Maxim 3-inch mountain gun carriages.

The other important items of manufacture during the year have been parts to alter or modify carriages of the older models that the rapidity and accuracy of fire from these models might be so increased as to render them as efficient as later designs.

Foundry.—The output of the foundry during the year has been about 900 tons of steel, iron, and bronze castings. The small plant for the production of steel castings recently installed has been operated throughout the year, and its product has been on the whole very satisfactory, both as to soundness of castings and physical qualities. The operations have been extended to the production of ingots to be used in the smith shop in the manufacture of small forgings, and this step has been attended with such excellent results that the practice of buying ingots or billets for small forgings has been practically abandoned. The production of iron and bronze castings has continued to be satisfactory.

The wooden parts of the foundry building, namely, roof, crane-way, galleries, and stairs should be replaced by iron constructions to prevent the possibility of disastrous fires which now exists.

Smith shop.—A large number of forgings for carriages under manufacture, for repairs to the armament and for other arsenals have been manufactured in this shop with great success as regards

soundness and physical qualities. The forging capacity is limited to the 6,000-pound hammer now installed, with rather inconvenient crane and furnace facilities for its operation. An increase of capacity with the installation of cranes and furnaces of improved type is very desirable.

Machine shop.—Sixteen new machine tools, including lathes, milling machines, shapers, drills, and boring machines, have been installed in this shop during the year, and with the introduction of the use of improved tool steel and a tool grinding room have permitted some improvement of shop methods and some decrease in the cost of manufacture. The installation is yet too recent to permit full realization of the benefits to be derived from the changes already made, and there still exists the disadvantage which has been mentioned in previous reports consequent upon the use of a large number of old machine tools not adapted to high-speed work. These existing conditions and the consequent increasing demand upon the present electric generating plant have resulted in taxing the latter to its full capacity, taking into consideration its ability to stand temporary overloads.

To meet present demands a new electric generating unit with engine should be installed as soon as possible, of such type that it may be utilized in any approved project for equipping the shop throughout with modern tools and motor drive.

Facilities for transportation.—The poor facilities existing for handling and weighing material received or shipped in carload lots and for the transportation of heavy weights from shop to shop have been mentioned in previous reports. The purchase of a locomotive crane of suitable capacity and the installation of tracks and turntables are necessary to correct the present inadequate and expensive conditions. An estimate of cost for this work is submitted.

Testing laboratory.—The testing laboratory has been busily occupied with current arsenal work, private tests, and tests of an investigative character. In the last-named class there has been continuation of the tests on frictional resistance of jacketed bullets forced through service rifle barrels, the examination of gun forgings with reference to the subject of streaks, and the investigation of the endurance of steels against repeated stresses.

Tests of ball bearings have been made, and a special apparatus is in process of construction to extend this series of tests under different conditions of loads and speeds.

An exhaustive series of tests have been made on the strength of 3-inch field carriage wheels, having fourteen and sixteen spokes, each with tires of varying thickness, assembled with different amounts of dish and with several types of hubs. The general scope of the tests was such as to include the wheels intact and the elements of strength

which contributed to the formation of a strong combination with lightness of construction.

A 17-ton steel ingot treated by the Harmet process and purchased from the manufacturers at Dusseldorf, Germany, has recently been received for examination and test to determine whether homogeneity of metal exists throughout the ingot, and whether it would be advisable to require ingots so treated to be used for ordnance forgings.

In the class of tests of industrial materials for civil engineering and architectural work the examination of concrete columns, plain and reenforced, has been continued. The importance which the cement industry has assumed in construction work makes these tests of a very general interest. Tests of brick piers will also form a part of this series. Constructive material was obtained at the Louisiana Purchase Exposition from most of the Western States and from a number of the Southern States, and the results of the tests will appear in the Report of the Tests of Metals for the year 1905.

Northern armament district.—The commanding officer of this arsenal is the armament officer of the northern district, and is charged with maintaining in an efficient condition the seacoast armament from Maine to the eastern entrance of Long Island Sound. The necessary inspections of the armament have been made, all necessary repairs have been promptly completed, and such alterations or modifications of the armament as have been ordered to increase its efficiency are well advanced toward completion.

NEW YORK ARSENAL.

This arsenal was commanded during the year by Col. John E. Greer, Ordnance Department, who is also chief ordnance officer, Department of the East, armament officer central armament district, and performs inspection duty.

The arsenal being mainly a purchasing and shipping agency, without facilities for manufacturing, its operations are necessarily those of purchasing, receiving, and issuing stores to the Army and Militia; it also receives through the custom-house such stores as are purchased abroad. Its other operations are necessarily confined to the care and preservation of the public buildings and the property stores therein.

Stores purchased and received from the Army were contained in 9,938 packages weighing 896,141 pounds.

Stores issued to the Army et al., packed and delivered to the depot quartermaster, were contained in 9,884 packages weighing 1,352,119 pounds.

All buildings have been kept in good repair. Roofs have received special attention, and the principal buildings, such as storehouses, shop, engine house, stable, and commanding officer's quarters have

been painted on the exterior. Interior repairs have also been made to many of the buildings.

Storehouse No. 3, which was partially destroyed by fire about eighteen months since, has been rebuilt.

All walks, roads, drains, gutters and the like have also been kept in good repair. In general, the grounds have been well policed and kept in good order.

Many sets of horse equipments, parts of infantry equipments, etc., have been overhauled and repacked for issue. Two hundred and twenty-five 12-inch projectiles have been unpacked, cleaned, painted, and repacked ready for shipment.

This arsenal is regarded as of great importance to the Ordnance Department as a purchasing and shipping agency and place of temporary storage of ordnance stores, but its principal value is as a depot for arming and equipping troops, especially of a military expedition, in time of war.

AUGUSTA ARSENAL.

This arsenal was commanded throughout the year by Lieut. Col. David A. Lyle, Ordnance Department, who is also a member of board on life-saving apparatus under the Secretary of the Treasury, armament officer southern armament district, and chief ordnance officer Department of the Gulf.

It is the headquarters of the southern armament district, and is a depot for supplying ordnance and small ordnance stores to the troops stationed in the South Atlantic and Gulf States, and to the National Guard and military schools and colleges in the same States. The repairs, alterations, and improvements necessary for the maintenance of the seacoast armament in an efficient and serviceable condition are made at this arsenal or by mechanics sent from it. In addition to the above, the work required for the care, preservation, and improvement of the public buildings, drains, vaults, fences, walks, and grounds has been performed.

The sanitary condition of the post is good, and the sewerage system satisfactory, so far as it has been extended with the limited water supply. The water supply is barely sufficient for present needs with the exercise of a rigid economy in its expenditure. An increase in this supply is imperative before any expansion of the work at this arsenal can be undertaken.

There is only one commissioned officer on duty here, and this is not sufficient for the proper transaction of the official business devolving upon this station. Owing to the lack of officers in the Department, it has heretofore been impracticable to assign another officer to duty at this arsenal, but one will soon become available.

During the last fiscal year Congress appropriated \$50,000 for machinery for this arsenal in the sundry civil bill. The expenditure of this money has already engaged the attention of the Department, which has taken the necessary preliminary steps to arrange for the outlay of the funds, with the object of assigning to this arsenal the manufacture of such ordnance stores and parts of ammunition as could be advantageously produced and could be temporarily laid aside at any time to take up the repair work found necessary to maintain the armament in a proper state of efficiency. This method would employ permanently, without loss to the Government, a sufficient force of mechanics to be able at all times to cope with the repair work on the armament, which from its nature must be more or less spasmodic.

Inviting attention to previous reports and considering the expansion contemplated by the appropriation above cited, the following recapitulation will give the most urgent needs of this arsenal in the order of their importance, namely, increased water supply, side track connecting with electric railway, installation of electric power and lighting to a moderate degree, and purchase of a limited amount of machinery.

BENICIA ARSENAL.

This is an arsenal of storage, issue, and repair. The ordnance supplies stored here are for the use of the troops of the Pacific coast stations and the fortifications of that coast, as well as to a certain extent for troops in the Philippine Islands. This arsenal was commanded from July 1, 1904, to July 10, 1904, by Capt. D. M. King, Ordnance Department; from July 11, 1904, to April 14, 1905, by Maj. F. E. Hobbs, Ordnance Department; from April 15, 1905, to May 18, 1905, by Capt. D. M. King, Ordnance Department, and from May 19, 1905, to the end of the fiscal year by Maj. J. W. Benét, Ordnance Department. The commanding officer is also ordnance officer of the Department of California and armament officer of the western armament district.

During the year the manufactures consisted of target material for seacoast forts, field batteries, and small-arms target practice; maneuvering material for seacoast forts, and parts of guns and carriages for the western armament district to replace those broken or of obsolete design. In addition, many repairs to guns and carriage parts were made. Two thousand two hundred and thirty-four magazine rifles were cleaned and repaired, and field-gun and rapid-fire saluting cartridges and field-gun rapid-fire and seacoast cartridges for target practice were prepared and issued.

The installation of the electric lighting and power system was completed, to be supplemented by an independent source of power in case

of failure, consisting of a generator operated by a steam engine previously used. Two motors for running the machines in the machine and carpenter shops were installed, and an electric rotary pump has been provided for pumping water from Carquinez Straits to the arsenal reservoirs, for which a steam pump, more expensive to operate, was formerly used, and about one-half of the 3-inch pipe of the water system, laid many years ago, has been replaced by 4-inch pipe.

A fire-control system has been provided for the shops and main storehouses, and a plant for resizing artillery metallic cartridge cases has been installed.

The following represents the volume of work of this arsenal during the year:

Expenditures, \$80,939.33; total weight of stores issued on quartermaster's bills of lading, 2,110,082 pounds; total weight of stores received on quartermaster's bills of lading, 1,789,948 pounds; number of separate issues, 2,030; number of separate receipts, 860; number of requisitions received, 766.

UNITED STATES POWDER DEPOT.

This depot has been commanded during the year by Maj. O. B. Mitcham, Ordnance Department, who also performs inspection duty. It was originally intended to be and is utilized for the storage, preparation, and issue of powders and ammunition for field, siege, and sea-coast guns.

In carrying out the plans for the enlargement of the depot, contracts have been let during the year for a wheel and dynamo house, a building for general shops, and nine storehouses for reserve supply of war material. The work upon these buildings has progressed but slowly since the contract was let in April, 1905. It is hoped, however, that more rapid work will be carried on, and that all the buildings will be completed for delivery by November next as required. After completion the shops can not be utilized to advantage unless an appropriation can be obtained for the necessary machinery to be installed. Such an appropriation has not yet been made.

To economically utilize the existing water power, a new dam with increased height should be built at the outlet of the present lake on the reservation. This would not only do away with the present weak and leaking dam, but would largely increase the amount of water available for development of power. The droughts of the past year and during the present season have shown the necessity for a large and immediate increase in the water supply for the post and for fire protection. Plans and estimates for a steel standpipe and for the necessary pumps and pipe lines have been submitted.

The rock-crushing plant that was recently installed has proved of great assistance and economy in furnishing broken stone for concrete,

for repairs to roads, and for supplying ballast to the railroad lines under construction.

This railroad, including main line and switches, will be, when completed, about $3\frac{1}{2}$ miles in length; the total amount completed to date amounts to about 2 miles. Appropriations for the present year will allow progress to be made on the remaining portion to be built, though the entire length can not be completed with the amount now available.

On June 30 the number of employees was 88. The disbursements for the year amounted to \$105,207.81.

The number of receipts and issues of stores during the year amounted to 523, requiring the handling of a total weight of 8,459,220 pounds.

MANILA ORDNANCE DEPOT.

The depot was commanded during the year by Maj. E. B. Babbitt, Ordnance Department, who is also chief ordnance officer of the Philippines Division. His assistant during the early part of the year was Capt. Kenneth Morton, Ordnance Department, who was relieved by Capt. D. M. King, Ordnance Department, U. S. Army.

Power plant.—During the year an electric-power plant and a nickel-plating plant have been installed at the depot, and both are now being operated in a very satisfactory manner. The primary features of the power plant consist of two boilers, a 75 horsepower steam engine, dynamo, and the necessary motors. With these improvements, the depot is now equipped with a plant which it is believed will meet all requirements except those pertaining to the larger guns which are to be installed for coast-defense purposes.

Storehouse.—In my last annual report I referred to the fact that the storage facilities are insufficient for the requirements of the depot. Estimates were submitted at the last session of Congress amounting to \$11,500 for removing the old casemates within the city wall fronting the Pasig River, and in their place to erect sheds to provide the necessary protected space for artillery and other storage purposes. This estimate failed to meet with the approval of Congress.

It has been customary for some time to store certain mobile artillery under the eaves of the only artillery-store shed at the depot, and to store the greater part in the open. The exposure of artillery material to a rainy season of several months and to a dry season with considerable heat, is most injurious to any of this kind of stores. Recently the Secretary of War directed that this artillery store shed be transferred to another location, and \$3,500 has been allotted for the purpose, but this in no way increases the storage capacity at the depot.

Office building.—The amount appropriated by Congress, namely, \$16,000, for completing the office building in process of erection

and unfinished when Manila was surrendered by the Spanish, was found to be insufficient when bids were received for completing the building by contract in accordance with the specifications. It is therefore contemplated completing the building without a contract, the work to be done under the supervision of the commanding officer of the depot.

Employees.—The force of clerks at the depot consists of 12 Americans and one native, but it is expected to reduce the number of clerks shortly to 11. The principal part of the work in the shops and storehouses is done by natives, the foreman and assistant foreman in each shop and storehouse being American. There are about 20 Americans and 160 natives continually employed at the depot. This does not include an enlisted force of 48 men who are employed in the various shops and storehouses and in performing guard duty.

Issues and receipts of stores.—All the troops serving in the Philippines are supplied with ordnance and ordnance stores from the depot, either directly or indirectly. The character and extent of this business will be appreciated from the fact that the total number of issues made during the year amounted to 1,623, involving a total weight of stores of 898 gross tons; 1,165 requisitions for stores were received during the year. The number of receipts of stores amounted to 923.

Among the principal issues were 4,500 aluminum cups and 4,500 aluminum meat cans, which were issued to troops for experimental purposes.

Among the other principal issues were 28 machine guns, 2 mountain guns, and 13 3-inch saluting rifles with their appropriate mounts, equipments, and proper supply of ammunition.

The principal quantities of small-arms ammunition issued amounted to over ten million rounds of ball cartridges, caliber .30, for the magazine rifle, and nearly two million rounds for the revolver, caliber .38. Four million rounds of caliber .30 ammunition for the magazine rifle, which were purchased abroad during the Spanish war, were shipped to the United States, as the ammunition was no longer thought serviceable for issue to troops.

The influence of the climate on stores will be appreciated from the fact that articles having an original value of over \$73,000, comprising over 83,000 items, were condemned at the depot.

During the year the commanding officer of the depot requested from the various regimental and post commanders in the Philippines Division reports regarding the sufficiency of the present authorized table of allowances of stores for issue. One hundred and fifteen reports were received in response to this request, and 36 reported the present allowances sufficient. The views expressed in the remainder of the reports were too varied with reference to the articles recommended for increase to warrant any change, with the exception of a few

articles on which there was some unanimity of opinion. In these cases the articles involved were cleaning and preserving materials, and the amount of increase brought out by these reports was about 50 per cent.

In this connection it may be stated it has never been the policy of the depot to restrict any organization in the Philippines Division to the allowances prescribed by the tables when the circumstances, in the opinion of the chief ordnance officer, justified a greater increase.

Fiscal affairs.—The expenditures made at the Manila Ordnance Depot during the year amounted to slightly under \$60,000.

Returns examined.—The number of property returns examined at the Manila Ordnance Depot and transmitted to this office amounted to slightly over 1,800. It has been deemed advisable to have all property returns given a preliminary examination with a view to correcting errors so as to save correspondence involved in case this preliminary examination was made in this office.

ORDNANCE BOARD.

Membership of the Ordnance Board June 30, 1905, is as follows:

Col. Charles S. Smith, Ordnance Department, U. S. Army; Lieut. Col. Wm. L. Marshall, Corps of Engineers, U. S. Army; Maj. R. Birnie, Ordnance Department, U. S. Army; Maj. George L. Anderson, Artillery Corps, U. S. Army; Maj. B. W. Dunn, Ordnance Department, U. S. Army.

The following is a list of the principal subjects reported upon during the year ending June 30, 1905:

Reference No.	Subject.	Date of report.
22396	Hotchkiss 1-pounder automatic gun	Aug. 24, 1904.
22396	McClean 1-pounder automatic gun (B. of O. and F.)	Sept. 29, 1904.
	3-inch field gun and field carriage, model of 1902, and the following experimental breech mechanisms:	
86524	3-inch Stockett eccentric block	Aug. 8, 1904.
86506	3-inch Tasker, continuous pull, eccentric block	
	3-inch Gerdorn, eccentric firing-pin bushing	
	3.2-inch Stockett eccentric block	
	3.2-inch Gerdorn eccentric block	
86222	3-inch, long-recoil, Ehrhardt field gun, No. 6, model of 1903, carriage, and limber, complete.	Dec. 3, 1904.
34827	5-inch R. F. gun and combined disappearing and barrette mount (B. of O. & F.)	Jan. 18, 1905.
84948	6-inch R. F. gun No. 1, model of 1900	July 18, 1904.
86158	Brown 6-inch wire-wound gun and mount	Dec. 17, 1904.
8710	6-inch wire-wound guns, Brown and Department designs.	June 18, 1905.
26537	Wear of Vickers-Maxim 6-inch	Apr. 15, 1905.
37331	10-inch B. L. rifle, No. 1, model of 1900	Dec. 24, 1904.
25645	Endurances of guns for accuracy	Indorsement, May 10, 1905.
38404	Range-firing 6-inch R. F. gun, model of 1900, on barrette mount.	June 12, 1905.
38222	Lining tube, 12-inch B. L. mortar, model of 1900, No. 88.	Sept. 13, 1904; Apr. 11, 1905;
13738	Automatic breech opener B. S. Co., on 5-inch gun, No. 18.	Jan. 30, 1905.
15621	Gerdorn 3-inch breech mechanism. Retracting firing-pin bushing.	Aug. 23, 1904.
86662	Automatic breech opener (experimental) 12-inch B. L. rifle, model of 1900, on 12-inch disappearing carriage, model of 1901.	Feb. 10, 1905.
80160	Experimental mechanical rammer, 12-inch disappearing carriage, model of 1901, No. 2.	Feb. 11, 1905.
		Indorsements: Aug. 4, 1904; June 23, 1904.

Reference No.	Subject.	Date of report.
15621.....	Gerdon gas-check pad, 12-inch rifle.....	July 6, 1904.
37512.....	Trunnion quadrant for 12-inch B. L. mortars (Captain Bottoms, A. C.).	Nov. 5, 1904.
37064.....	3-inch pilot carriage, model of 1902, with cylinder 45-inch recoil.	Indorsement, Oct. 18, 1904.
37064.....	3-inch field carriage, No. 6, model of 1902.....	{ Nov. 21, 1904; Apr. 22, 1905; supplementary to report of Aug. 8, 1904.
30024-F.....		
38378.....	6-inch disappearing carriage, L. F., No. 12, model of 1903.	Indorsements: Oct. 15, 1904; Nov. 19, 1904; Dec. 12, 1904; Mar. 15, 1905.
38404.....	6-inch disappearing carriage, L. F. model of 1903, No. 57.	May 21, 1905.
35062.....	6-inch barbette carriage, model of 1900, No. 32.....	Indorsements: July 25, 1904; Oct. 6, 1904; June 8, 1905.
37439.....	10-inch disappearing carriage, L. F., model of 1901, No. 1.	Apr. 10, 1905; Apr. 19, 1905; May 1, 1905; May 23, 1905; June 2, 1905.
37198.....	12-inch disappearing carriage, L. F., model of 1901, No. 3, adjustment of throttling bars.	{ July 26, 1904; Feb. 21, 1905.
33555-F.....		
33555.....	12-inch mortar carriage, model of 1896, No. 290, modified, with side frames.	June 8, 1905.
38378.....	Firing battery for guns on disappearing carriages..	Apr. 29, 1905; Feb. 14, 1905.
37791-181.....	Safety lanyard attachment for guns on disappearing carriages.	Indorsement, Jan. 17, 1905.
30024-BBB.....	Detonating fuzes.....	{ Indorsements: Aug. 27, 1904; Mar. 7, 1905; June 8, 1905; June 28, 1905.
17586-240.....		
30024-BBB.....	Fuzes for 12-inch mortar shell, water impact.....	Mar. 8, 1905.
38651.....	Hacherelle mechanical time fuze.....	Indorsements: June 27, 1904; Nov. 23, 1904.
38363.....	12 M percussion plunger (George).....	May 19, 1905.
38505.....	Minor caliber fuzes (Sample).....	Indorsement, June 5, 1905.
38522.....	Base percussion fuze (Watson).....	Indorsement, Apr. 20, 1905.
38512.....	Thorn saluting charges, smokeless.....	Indorsement, Sept. 30, 1904.
38512.....	Smoke-producing compound in 3-inch shrapnel (Schou).....	Indorsement, Oct. 20, 1904.
31627.....	Ignition of fixed ammunition for field gun.....	Indorsement, Sept. 30, 1904.
37514.....	Zone limits and velocities, 7-inch B. L. mortar with smokeless powder.	June 20, 1905.
38635.....	Powder for 6-inch R. F. gun, model of 1900.....	Nov. 23, 1904.
6637.....	Noncombustible cloth for powder bags; California Powder Works.	Oct. 17, 1904; Jan. 7, 1905.
37438.....	Ballistics of 12-inch B. L. mortar.....	Indorsement, Dec. 12, 1904.
33853.....	Absorption of moisture by smokeless powder.....	Indorsements: Mar. 4, 1905; Apr. 24, 1905.
31627.....	Flare back from guns.....	Apr. 15, 1905.
37514.....	Incendiary effect of high-explosive shell.....	Indorsements: Mar. 17, 1905; May 2, 1905.
37514.....	Relative value of A. P. shot and shell charged with high explosive.	Indorsement, June 30, 1905.
23100.....	Force of high explosive bursting charges.....	Nov. 2, 1904.
25532.....	Ammunition belts for continuous feed, 87 mm. Vickers-Maxim 1-pounder automatic gun on mountain carriage.	Nov. 8, 1904.
38535-1.....	Relative value of capped and uncapped shell in mortar fire.	Oct. 11, 1904.
31627-1240.....	Comparison of army and navy 12-inch shell for accuracy in flight.	Reports: Dec. 24, 1904; Dec. 31, 1904.
30024-BBB-91.....	F. A. shrapnel, circular and hexagonal cases (steel balls for penetration).	Dec. 17, 1904.
38530-10.....	Test of trajectory under water.....	Indorsement, Nov. 23, 1904.
35543-112.....	Deck armor with 8, 10, and 12 inch A. P. shell capped at various angles of incidence.	May 4, 1904; Jan. 19, 1905.
35543-151.....	High-explosive shell against 7-inch steel plate, oblique impact.	Nov. 23, 1904.
35543-138.....		
35941.....	4.5-inch Krupp shields, Nos. 1 and 2, on B. S. Co. 6-inch rapid-fire guns.	Indorsements: May 8, 1905; Apr. 29, 1905.
4613-B.....	Methods of illumination range and azimuth scale, W. and S. Dep. rangefinder.	Mar. 7, 1905.
35523-176.....	Asimuth instrument model of 1904, F. A. with Poro erecting prism.	Indorsement, Sept. 8, 1904.
23565-F.....	Elevation indicator (Bishop), 12-inch mortar.....	Indorsement, Nov. 8, 1904.
38020.....	Davis automatic sight.....	Dec. 15, 1904.
37499-156.....	Telescope for use of battle and fire commanders.....	Indorsement, June 29, 1905.
38020.....	Automatic sight for guns (Capt. A. S. Fleming).....	Apr. 22, 1905.
34760.....	Removable sight for rapid-fire guns (Thos. C. Harris).....	Indorsement, June 10, 1905.
38020.....	Clarke sight, automatic.....	Indorsement, Aug. 12, 1904.
30024-BBB-121.....	Electric and percussion primers in 15-pounder rapid-fire, 4.72, and 6-inch Armstrong guns.	Indorsements: June 14, 1904, et seq.
34948-81.....	F. A. combination electric-friction primer, modified with metal bushing.	Indorsement, Jan. 4, 1905.
38787.....	Anesthetic for filling shell (C. M. Wheaton).....	Indorsement, June 20, 1905.
37791.....	Macon-Evans liquid cement for fuze threads.....	Indorsement, May 28, 1905.
26870.....	Crystallite paint compared with Rubberine.....	Do.

in the present service rifle, and embodied all of the improvements which the skill at the armory had been able to introduce, and orders had been given, with the approval of the Secretary of War, for the manufacture of 5,000 of these rifles for issue to the service in order that a proper trial in the hands of troops might determine whether the new rifle should be adopted for the service, superseding the Krag-Jorgensen. The guns intended to be manufactured were to be equipped with the rod bayonet, but the length of barrel was the same as that of the service rifle, 30 inches.

3. As preparations for the manufacture of these 5,000 rifles proceeded I became impressed with the slowness of this process of determining the suitability of the new arm, involving as it did a continuation of the manufacture of the Krag-Jorgensen for a long period, and with the unsatisfactoriness of the method by which it was proposed to arrive at a conclusion. There being no wars in progress, and very little active service involving the use of the rifle, there could have been had in the service only the same kind of trials and tests as those which had been previously made at the armory, but under much poorer conditions and by people with whom the trials of the gun and the reports thereon would be only incidents of their duties. The method also involved the manufacture of a large number of the new rifles after only such sanction as had been given to this expenditure by trials of the gun in the hands of officers and employees of the Ordnance Department alone. Upon a representation to this effect and the recommendation of this Department a board was appointed of the following membership: Capt. Frederick S. Foltz, Second Cavalry; Capt. Frank DeW. Ramsey, Ninth Infantry; Capt. Fred. L. Munson, Ninth Infantry, and Capt. Tracy C. Dickson, Ordnance Department.

The board was directed to ascertain, first, if the new rifle was a suitable one for the United States service; second, if it was sufficiently superior to the service rifle to justify its substitution therefor in the service, and, third, what modifications or changes, if any, were needed or recommended before its issue for general trial by troops. Seven noncommissioned officers were assigned to duty with the board to assist in all the trials of the rifle; and the board and this detachment of enlisted men were directed to proceed first to the Springfield Armory, there to familiarize themselves thoroughly with the operation and manufacture of the rifle, and afterwards to proceed to the Sandy Hook Proving Ground, N. J., to complete the firing tests of the gun. The commanding officers of these two establishments were instructed to afford the board all possible facilities for the performance of its duty. The board met at Springfield on February 16, 1903, and submitted its report on March 28 of the same year.

4. I will first consider the subject of the barrel. Of this the board tested four lengths, 22, 24, 26, and 30 inches. The elements which may be affected by the length of the barrel are the velocity, the accuracy of aim, and the reach when the gun is used as a pike. The last feature concerns the use of the gun with the bayonet. With the cartridge first furnished the velocity of the bullet fired from the 24-inch barrel was 87 feet less than from the 30-inch barrel; but this difference was removed by the development of a cartridge with which the velocity was made the same with both lengths of barrel by the use of a slightly larger charge of powder. As the bullet used with both lengths of bar-

rel is in all respects the same as that used with the present service rifle the relative range and penetration are dependent wholly upon the initial velocity. In regard to the general accuracy of the rifle the board reports as follows, the experimental carbine mentioned in the table having a length of barrel of 22 inches:

Each marksman was required to make a target on the same day with all the arms tested, in order that the conditions of wind, light, temperature, etc., should be as nearly identical as possible for the targets made by him at each range and the results obtained to be comparable. Each target consisted of ten consecutive shots, of which the mean absolute deviation in inches is recorded in the following tables:

[Range, 500 yards.]

Marksman.	Experimental rifle.			U. S. magazine rifle, model 1898.	Experimental carbine.	
	30-inch barrel.	26-inch barrel.	24-inch barrel.		8-inch twist.	10-inch twist.
Captain Foltz.....	6.79	7.49	7.38	12.42	9.81	7.37
Captain Ramsey.....	7.29	10.04	7.45	10.75	8.08	.....
Captain Munson.....	7.29	7.06	6.43	6.32	10.67	11.18
Sergeant-Major O'Keefe.....	11.40	10.20	8.24	9.33	9.12	14.80
First Sergeant Scholle.....	8.19	10.10	10.90	9.65	14.70	.....
Quartermaster-Sergeant Leaback.....	11.00	9.89	9.37	9.69	16.50	.....
Quartermaster-Sergeant Siemens.....	5.68	.....	8.10	13.10	.....	.....
Sergeant Collins.....	9.94	9.79	12.15	11.80	8.67	.....
Sergeant Hall.....	8.60	8.37	8.21	9.79	.....	.....
Corporal Saalbach.....	11.80	9.10	10.60	10.26	.....	.....
Average.....	8.80	9.12	8.88	10.31	11.06	11.12

The results obtained at this range, together with other considerations, caused the board to suspend firings for accuracy, etc., with the 26-inch experimental rifle and the experimental carbines.

[Range, 1,000 yards.]

Marksman.	Experimental rifle.		U. S. magazine rifle, model of 1898.
	30-inch barrel.	24-inch barrel.	
Captain Foltz.....	31.64	17.80	22.50
Captain Ramsey.....	21.15	11.50	33.00
Captain Dickson.....	15.70	26.50	26.90
Captain Munson.....	14.80	15.20	21.40
Sergeant-Major O'Keefe.....	13.50	26.10	11.90
First Sergeant Scholle.....	22.46	25.04	19.40
Quartermaster-Sergeant Leaback.....	21.15	20.75	14.45
Quartermaster-Sergeant Siemens.....	19.85	15.30	26.45
Sergeant Collins.....	19.80	18.85	18.80
Sergeant Hall.....	28.10	24.90	28.30
Corporal Saalbach.....	25.50	26.45	17.70
Average.....	21.24	20.81	21.81

After repeated efforts to obtain accuracy targets at 1,500 yards under the conditions imposed—namely, that all three rifles should be fired by the same marksman under identical weather conditions at each range—it became evident to the board that if this part of the programme was completed its report would be unwarrantably delayed, because of the stormy and foggy weather prevailing here at this season of the year. All accuracy firings at and beyond 1,500 yards were therefore omitted. A number of targets with the three rifles were obtained at 1,500 yards, and they show that the experimental rifle is more accurate at that range than the present service arm and that the 24-inch is practically as accurate as the 30-inch barrel. These results at 1,500 yards, together with those obtained at 500 and 1,000, show that the barrel of the experimental rifle can be reduced in length from 30 to 24 inches without sacrifice of appreciable accuracy.

It will be observed from the first of the above tables that at the range of 500 yards the 24-inch barrel gave better accuracy than either the 22-inch or the 26-inch, and was within 1 per cent of the result attained with the 30-inch barrel; while at a 1,000 yards range its accuracy was superior to that of the 30-inch barrel, and at both ranges it was superior to that of the Krag-Jorgensen rifle.

5. Upon the subject of the suitability of the general design of the rifle for the military service the board reported as follows:

These tests show that the degree of skill and effort required for its manipulation are less than that for most arms of the same type, and that while the 30-inch barrel rifle is easily handled, the 24-inch is more easily handled under all conditions.

6. Concerning the recoil of the piece the following is stated:

In all the firing done by the members of the board and by the noncommissioned officers the recoil of the experimental rifle with the 24-inch barrel was not noticeably greater than with the present service arm.

7. Under the heading "Test of rapid-aimed fire to establish the comparative value of the rifle at the critical stage of action" the board reported as follows:

It was assumed by the board that an enemy, during the final charge after ceasing fire, would occupy about one minute in reaching the intrenchments of the defense. Each of the members of the board and the seven noncommissioned officers fired for one minute at a target 6 feet high by 2 feet wide at a 100-yard range, position kneeling or prone, as the firer elected, but to remain the same throughout the test of the three rifles. For magazine fire the clips were carried in a pocket belt worn by the firer and loaded therefrom; for single-loading fire the cartridges were carried in the present service belt and loaded therefrom; with magazine fire the test commenced with the magazine filled and gun loaded, and with single-loading fire the test commenced with the gun loaded.

This comparative test shows, when rapid-aimed fire is used, that: (1) The experimental rifle is superior in rapidity and accuracy to the United States magazine rifle, model of 1898, when both are used as magazine arms only. Notwithstanding the familiarity of the marksman with the latter arm, the experimental rifle exceeded it 9.3 per cent in rapidity and 18.6 per cent in hits on the first trial of both guns. The rapidity of fire obtained with the United States magazine rifle is believed to be a maximum, as the marksmen were thoroughly familiar with its operation. A comparison of the result of the third and fourth trials shows that in rapidity the experimental rifle exceeded the service arm by 19½ per cent and in hits by 34.9 per cent. A comparison of the average of the results obtained in the eighth and ninth trials with that of the seventh shows that the new rifle exceeded the service arm by 21.1 per cent in rapidity and 17.4 per cent in hits.

8. In making a general comparison between the 24-inch and the 30-inch barrels, both for the experimental rifle, the board said:

A comparison of the 24 and 30 inch barrels shows that—

First. The former is 0.72 pound lighter than the latter, but as the 30-inch rifle must also have a full-length hand guard, the saving in weight will be somewhat greater.

Second. The former is equally accurate.

Third. The former will have the same penetration when its muzzle velocity is increased to 2,300 feet per second.

Fourth. The former can be more easily manipulated and is better balanced.

Fifth. The length of the former is such that the same gun can be issued to all branches of the service without the slightest modification.

The board therefore recommends that the length of the barrel of the experimental rifle be reduced to 24 inches, and that all troops of the Regular Army be equipped with the same arm, accessories, and cartridge belt.

9. In reviewing the proceedings of the board and the conclusions which it reported weight must be given to the following important statement:

The board was unanimous in its action on each opinion, suggestion, and recommendation contained in this report.

10. After the conclusion of the work of the board as a body the members separated and each, with the exception of Captain Dickson, taking some of the noncommissioned officers with him, visited several military posts, where they exhibited the rifle to the officers and men of the command, explained the proceedings of the board, and made a sufficient number of firings to show the characteristics of the piece. The opinions of the officers and men at the posts were considered by the officers of the board and a report was made by each to the Chief of Ordnance.

11. Captain Foltz visited Madison Barracks, Plattsburg Barracks, and Fort Ethan Allen. In regard to the length of the barrel he stated as follows in his individual report:

The idea of the short 24-inch rifle, with its consequent saving of weight and handiness, was very favorably received at both of the infantry garrisons, and at the cavalry station no objection was expressed to carrying the extra 2 inches of length of barrel as proposed, nor to the necessary increase of three-fourths of a pound weight beyond that of the present carbine.

The cavalry appreciate fully, I think, the advantage they gain in getting a bayonet for sentry duty and foot work, the stacking swivel, and the sling for use on foot when the hands are occupied, and I believe they are generally of the opinion that the short rifle is quite as handy as the carbine and better balanced for both aiming and for manipulation in loading.

It is proper to note that, although it was remarked that the recoil was greater than that of the present rifle, no serious complaint was made as to its severity, though many men shot in their shirt sleeves.

I heard no one express a preference for the long rifle. The garrison at Plattsburg had recently reported against a reduction in length of the present rifle. I therefore made it a point that their best shots should shoot with the short and long barrel alternately at 600 yards, with the result that they expressed themselves in favor of the short barrel.

I have not heard any cavalryman express a preference for a shorter barrel than the 24-inch shown, nor any objection to having a rifle identical with that of the infantry, including the stacking swivel, the bayonet, and the sling.

To resume, the reception of the new rifle with 24-inch barrel has been most flattering; much less conservatism has been encountered than was expected, and the conclusions of the board have been strongly confirmed.

12. He received written statements of opinions from some of the officers, from which the following are extracted:

From Colonel Robe, Ninth Infantry:

I have the honor to state that I am in favor of the new short-barreled rifle notwithstanding its present drawbacks, as in the friction of bolt, its liability to drop out under certain conditions, the clip and its claw, and the deposit of cartridges from clip into magazine, regarding the imperfections as all readily overcome.

From Lieutenant Gibson, Ninth Infantry:

I myself and all the noncommissioned officers and privates of the company are greatly pleased with the 24-inch barrel, experimental rifle. I judge from the test scores, which I witnessed at this post, that the 24-inch model is quite as accurate as rifles with longer barrels, and there can be no question that the shorter rifle is the more convenient under general circumstances and especially in the thick underbrush of tropical countries, such as the Philippine Islands, Cuba, and South America.

From Captain Palmer, Ninth Infantry:

I am fully convinced that the new model 24-inch barrel rifle is greatly preferable for military purposes to any of the other forms and to the Krag-Jorgensen; and I accordingly favor its adoption.

13. Captain Ramsey visited the posts of Fort Myer, Fort McPherson, Fort Columbus, New York, and Washington Barracks, and also exhibited the rifle to the officers of the Navy and Marine Corps at the

Washington Navy-Yard. He reported as follows concerning the length of the barrel:

The unanimous opinion of all officers to whom the rifle has been shown is:

First. That it is suitable for the military service.

Second. That it is much superior to the rifle now in use.

Third. That it should be adopted for all branches of the military service.

Captain Ramsey concludes as follows:

At Atlanta several of the expert shots of the well-known Georgia rifle team experimented with the rifle and were highly pleased with it.

In conclusion, I would unhesitatingly express my belief that the new experimental rifle with the 24-inch barrel is the best military arm in existence, and I recommend that it be adopted for all troops armed by the United States.

14. Among the opinions received in writing by Captain Ramsey are the following:

By Colonel Price, of the Sixteenth Infantry:

I have asked the opinion of all the company commanders and staff officers (the older shots) as to the suitability of the new rifle, and all of them recommend its adoption.

I heartily concur in this recommendation, and hope that it may be in the hands of the troops before long. Everyone was tremendously impressed by the advantages it possesses over any rifle we have used.

By Major Burr, Corps of Engineers, commanding Washington Barracks:

The rifle is thought to be an improvement over the present arm, and to present several advantages.

The rear sight is improved, although the sight radius is much shorter than in the present arm, but the latter is compensated for by bringing the rear sight nearer to the eye.

The piece is lighter, but it is not thought to be so well balanced as the present arm.

By Captain Brett, of the Second Cavalry:

In my opinion the 24-inch rifle is a superior shooting arm to that at present in use, but it will require some changes to make it suitable for cavalry service.

A carbine of the same pattern, with the rear sight set farther back and the addition of a gun sling, would, in my opinion, answer equally well, and would not add any extra weight to the cavalry equipment, nor would any change be required in the present carbine scabbard.

By Captain Kochersperger, of the Second Cavalry:

The new carbine and rifle shown by Captain Ramsey is a better weapon than our present carbine in regard to range, accuracy, and penetration. It is too long and heavy to be used as a carbine.

By Captain Trout, of the Second Cavalry:

No length of barrel should be permitted over and above that necessary to render the arm as accurate up to 1,000 yards as the present rifle.

By Lieutenant Martin, of the Second Cavalry:

I have the honor to state that in my opinion this rifle is an improvement on the Krag-Jørgensen carbine in use at present by our troops.

By Lieutenant Smith, of the Second Cavalry:

For cavalry it may be a little too long and heavy for packing on the saddle; in all other respects I consider it a better weapon than the one we now have.

By Lieutenant Gordon, of the Second Cavalry:

I tried the rifle on two different days, observing about 60 shots in all at ranges in the neighborhood of 100 yards. From my observation I am of the opinion that marksmanship of great accuracy is possible with this gun.

15. Captain Munson visited Fort Thomas, Columbus Barracks, Ohio, and Fort Wayne. He reports the views of the officers and men of Columbus Barracks as follows:

Upon the completion of these firings both officers and men spoke most enthusiastically of the shooting qualities of the short rifle and appeared to be unanimous in their opinions as to its superiority over the Krag.

And of those at Fort Wayne as follows:

As there was no target range at or near Fort Wayne no demonstration of the rifle took place other than an exhibition of its mechanism. Everyone was heartily in favor of the adoption of the short rifle.

16. Captain Dickson visited Fort Leavenworth, and as the result of his exhibition of the rifle at that post stated, among other things, the following:

Infantry.—The officers and men of this arm of the service were practically unanimous in their praise of the gun, and desired its adoption.

17. The rifle was thus exhibited at 10 posts, at which there were serving 223 officers and 4,669 enlisted men.

18. The new rifle was also referred to the infantry board at Fort Leavenworth, Kans., and to the cavalry board at Fort Riley, Kans., both of which unanimously recommended the adoption of 24 inches as the length of barrel for all arms of the service.

19. Among all the expressions received none were in favor of the long barrel as against that of 24 inches length.

20. The above shows as careful consideration as it seemed possible to give it of the subject of the proper length of the barrel, and by methods which I do not now know how to improve upon. The line officers of the board were all expert with the rifle, and the ordnance officer was expert both with it and in its manufacture. Two of the line officers, Captain Ramsey and Captain Munson, had seen active service in the Philippine Islands, in China, and in Cuba, and Captain Foltz had seen such service in Cuba. I consider it a great advantage that these officers, after having been carefully selected, were withdrawn from their duty and instructed to give all their time and thought and attention to the subject which they were directed to consider, with the benefit of discussions among themselves and with the large number of officers at the posts which they visited. As a single question was under consideration, it was possible to make the trials more thorough and more varied than those which preceded the adoption of any previous small arm, as known to this Department. Nothing having since arisen which was not considered by the board or to throw doubt upon the conclusions which it reached in regard to the length of barrel, as this feature concerned the characteristics of the piece as a shooting weapon, it is recommended that this question be not reopened.

The comparative field trial of 24-inch and 30-inch barrels, spoken of by the President, could not very well be made by firings with the Krag-Jorgensen rifle and with that of the new model; both for the reason that the distance between the sights on the Krag-Jorgensen is not as great as it could be made with the 30-inch barrel on the new rifle, and because other elements affect unfavorably the accuracy of the Krag-Jorgensen as compared with the new gun. Such a trial would therefore require the manufacture of some 500 of the new model rifles with a barrel 30 inches in length, the cost of which would be

about \$7,000. For 500 men to fire 100 rounds apiece from each of the two lengths of barrel would require 100,000 rounds of ammunition, which would cost about \$3,000. It is thus seen, as far as the cost is concerned, the figures are not prohibitive. The 30-inch barrels could afterwards be cut off to the standard length, and the guns utilized.

21. In regard to the rod bayonet the following expressions are found in the report of the board:

Bayonet test.—For this test a butt was made of alternate layers of white pine and air, each 1 inch thick. A bayonet was fixed and driven into the butt by the regulation bayonet lunge executed with as much force as possible. In eight trials the penetration varied from 2 to 2½ inches, and two bayonets were broken by the same noncommissioned officer, who did not execute the lunge properly. The bayonet tested, when fixed, projected 15½ inches from the muzzle. In the opinion of the board this length is unnecessarily great and a source of weakness.

Defects.—The bayonet is unnecessarily long. The section in rear of the point is knurled, which would increase the effort required to withdraw it from the human body and is liable to carry infection into the wound. A cleaning-rod head is provided for screwing on the lower end of the rod bayonet, so the latter can be used for cleaning the bore, whereas the use of a steel cleaning rod would injure the rifling and burr the muzzle.

Recommendations.—The length of the bayonet should be reduced so its point when fixed will project 10 inches beyond the muzzle. The knurling should be replaced by a smooth groove of the same length and of the same depth at its middle point as the catch slot. The diameter of the rod should be the same throughout its entire length and have its lower end flat with a well rounded edge. The cleaning-rod head should be omitted. The use of the rod bayonet in the bore, except when necessary for removing mud or a cartridge shell, should be prohibited. For cleaning the bore, see recommendation under section (d) of Part II.

In recommending the adoption of the rod bayonet the board was influenced by the weight saved, the unsatisfactory means provided for carrying the knife bayonet, the unavoidable noise made by the bayonet in its scabbard, the frequent loss of the bayonet in the field, that the use of the bayonet with a clip-loading magazine arm will be very limited, and that as a matter of fact the muzzle of a military rifle carries with it a well-known moral effect regardless of the presence of a bayonet.

22. In his individual report Captain Foltz states as follows:

The rod bayonet was considered a desirable substitute for the knife bayonet; though the officers and men of the Ninth Infantry generally advocated the carrying of a bolo on Philippine service, as a side arm and intrenching tool.

Among the written opinions submitted to him by officers are found the following:

By Captain Noyes, of the Ninth Infantry:

A good knife is an important accessory in the Philippines. When, as in the new rifle, the bayonet can not be used as a knife, a knife or bolo should be provided. It should be of such form that it can be used advantageously as a cutting tool, a cutting and stabbing weapon, and an intrenching implement for making a hasty intrenchment for one man. It should not be used on the muzzle of the rifle.

By Lieutenant Gibson, of the Ninth Infantry:

I believe the rod bayonet on this 24-inch model, if firmly fastened in the piece, will be quite effective as to strength and piercing power and will have almost as great an effect as to the moral confidence of the troops using it. For troops serving in the Philippines or other semicivilized communities and for tropical countries, I would recommend that each man be furnished with a bolo, as a weapon in the first case, and as a chopping tool in the second case.

By Captain Palmer, of the Ninth Infantry:

I heartily favor the rod bayonet (not over 10 inches long), but the spring to hold same in place should be strong and the slots deep enough to permit a very firm hold, so as to avoid the rod becoming loosened while piece is being fired, or when rod is used as a bayonet.

In view of the above, which involves the abolishing of the present bayonet and scabbard, I recommend provision (for use in active service in the field and whenever a side arm may be necessary for men otherwise unarmed) of a "bolo" (similar to the "bolo" bayonet recently issued for experimental purposes). This makes an efficient side arm, as it is an excellent cutting or thrusting weapon, and is, besides, well adapted for use as a knife or hatchet, and as an intrenching tool to obtain quick cover for one man. It should not be arranged to use as a bayonet and should be carried only in active field service, or, in garrison, only when among a population of doubtful fidelity of allegiance and when the soldier would otherwise be unarmed.

23. From the individual report of Captain Ramsey there is the following:

After discussion with many officers of all services who are interested in the subject, I make the following recommendations. * * * The rod bayonet should be retained for ordinary service. For special service, as among savage tribes, a special type can be provided.

The following opinions were submitted to him by Major Burr, Corps of Engineers, commanding Washington Barracks:

The substitution of a rod bayonet for the present knife bayonet is not approved. It is believed that the knife bayonet should be retained on account of its usefulness in breaking up soil when necessary in obtaining hasty cover in the field. Recent experiments have shown that, short of substantial intrenching tools (picks and shovels), the best implements for obtaining quick shelter are the knife bayonet and the tin cup or meat can or even the soldier's hands. Of these implements the one most essential is the knife bayonet. It has been found that a tool for breaking up the ground is absolutely necessary, and that the knife bayonet will serve this purpose fully as well as any implement that can be regularly carried upon the soldier's person. A pick is of course better, but it is not expected to be regularly carried by the soldier. Given a knife bayonet, or its equivalent, the soldier can quickly protect himself, using his tin cup or meat can or even his hands for scraping up the earth once it has been broken by the bayonet. If the knife bayonet be removed from the rifle, its equivalent must be furnished to the soldier if he is to be in a position to properly protect himself in the field. No saving in weight would therefore appear to be gained by the substitution of the rod bayonet for the present knife bayonet.

Additional comments have been made upon the substitution of the new rod bayonet for the old knife bayonet. These comments are adverse to the change and based upon the reasons stated in my former letter. The principal of these reasons may be stated shortly, that the old knife bayonet served many useful purposes in addition to its value as an intrenching tool, and is, moreover, a good bayonet. The necessity of carrying a special intrenching tool for breaking up the ground in case the old knife bayonet is replaced by the proposed rod bayonet is reiterated.

24. Captain Munson, in his individual report, says:

The enlisted men had no criticisms whatever to offer, nor had the officers, with the exception of a very few, on the subject of the rod bayonet.

The arguments presented by these officers against the adoption of a rod bayonet were as follows:

As it does not resemble a bayonet in form it is therefore lacking in moral effect.

That it is too slender to produce a "knock out" wound.

That such a bayonet has already been tested by the Army and found wanting.

That as the successes of many battles in the past were largely due to the bayonet charge, in order to continue these successes in the future a long, dangerous-looking bayonet is absolutely indispensable to the infantry soldier.

To the above statements I replied in brief as follows:

In my opinion the usefulness of a bayonet as an attachment to a military arm diminishes in proportion to the rapidity with which that arm can be fired.

Because battles were frequently won by the bayonet charge against an enemy armed with a gun that could not possibly be loaded and fired faster than twice in one minute, it certainly does not follow that in the future such successes are going to be numerous against an enemy trained to hold its trenches, and in whose hands is a modern rifle from which ten times that number of aimed shots can be fired in the same period of time.

From experience gained by the Ninth Infantry in resisting bolo attacks while serving in Samar, Philippine Islands, the present broad bayonet was found to be

objectionable, as in many cases, when thrust into a human body, it could be extricated only with the greatest difficulty. From the form and size of the rod bayonet such an experience as above described could hardly be expected to occur.

As it is almost certain that the infantry soldier will soon be equipped with an intrenching tool, the question of the additional weight a man will be required to carry must be seriously considered.

The substitution of the rod bayonet for that of the present type produces a saving in weight of $1\frac{1}{2}$ pounds.

Its other good features are that it is much more readily adjusted than any other form of bayonet, and is instantly available for use as a means for driving out mud from a choked bore or a shell from the chamber, should one fail to extract. In other words, the rod bayonet is a compromise over all other types, with a large majority of points in its favor.

Many of the officers who had previously offered objections to the possible adoption of a rod bayonet publicly withdrew them after I had replied to them as above quoted.

In regard to the characteristics which an intrenching tool should possess, he states as follows:

Although I have not been instructed to report upon a prospective intrenching tool for the infantry soldier, still, as so many questions were recently asked me about it during my recent trip, I believe the Ordnance Department would care to know that if such a tool were constructed resembling a small spade in form, the blade of which to be composed of a metal sufficiently soft to prevent its being easily bent or broken, and still of sufficient hardness that one or both of its edges can be sharpened and the instrument used as a hatchet or bolo, I feel quite confident in saying that such an intrenching tool would be very favorably received by all who would be required to use it. A combination tool that will really dig and really cut is most urgently required.

25. It will be noted that Major Burr considers the bayonet in use with the Krag-Jorgensen rifle to be a good intrenching tool, and that there is no need to abandon it for a better implement for this purpose. On the other hand, there are found objections to the use of any intrenching tool which also serves as a bayonet; the reasons usually given being that the latter use is apt to involve digging with the bayonet while it is attached to the gun, and the danger of bending the barrel or of clogging it up with earth.

26. Before the appointment of the board I remarked as follows in regard to the rod bayonet, in my annual report for the year 1902:

The "rod bayonet," as it is called, has been considered before, but has never received a thorough trial in the service. Its great advantage is that it lightens the weight made up of the gun, bayonet, and bayonet scabbard, and by dispensing with the latter two as separate articles to be carried permits the soldier to carry with him an intrenching tool of sufficient size and weight to be serviceable. There are differences of opinion as to the value of the rod bayonet; although less effective as a bayonet alone than the one now in use in the service, it is undoubtedly of some value in converting the musket into a pike, and in view of the increasing prominence of the intrenching tool and the decreasing occasion for the use of the bayonet its experimental substitution is in line with apparent progress in subordinating the latter to the former.

It will be noticed that it was appreciated that things could be said both for and against the use of this implement, but in view of the great preponderance of opinion of practical officers in favor of the new rifle, including the rod bayonet, I recommended to the Secretary of War that the unanimous conclusions of the trial board, reenforced by those of the infantry board and the cavalry board, be accepted and that the new arm be adopted. I did not make this recommendation, however, without assurance by examination that, should it subsequently be considered advisable to go back to a bayonet of a form which had been previously used, there would be no difficulty in attach-

ing to the new rifle either the bayonet which is used with the Krag-Jorgensen or, indeed, one of almost any other type, without involving radical or expensive alterations.

27. Reports which have been made by officers recently returned from duty with the Japanese army in Manchuria supply information which seems to indicate a still greater confirmation of the lesson of previous wars, notably of that in South Africa, that the increasing efficiency of the rifle was operating to prohibit the ground in front of troops in position to assaulting troops, and that this might in some cases be supposed to have proceeded so far as to force the abandonment of the attack of such positions by daylight, and the recourse to the method, heretofore considered almost impracticable, of night attack, the means for carrying out which as a regular operation will apparently have to be learned. There is thus the somewhat singular effect of the excellence of the rifle that it in some cases necessitates the abandonment of an attempt to face it, by the introduction of conditions under which hand-to-hand fighting may be again expected. This development constitutes a new consideration, and if it can be regarded as established the bayonet again becomes a weapon of first-class importance, and must be so designed as to be an efficient instrument. From this point of view the rod bayonet fails to meet the requirements, as it is not, and never was thought or intended to be, a thoroughly efficient weapon for purposes of hand-to-hand combat. The question of its use would therefore seem to be one which should properly be reopened, and as it can be easily changed, and as no issues of the new rifle have yet been made to troops, the subject of the adoption of almost any form of bayonet can be considered without embarrassment. The subject would seem to be a proper one for consideration by the General Staff. Several rifles are now being fitted with bayonets of different forms and will shortly be ready for examination.

28. A copy of the report of the board of officers mentioned herein is inclosed.

29. The letter of the President inclosed with your note refers also to the sword carried by officers. This sword was prescribed by General Orders, No. 81, of July 17, 1902; a cut and description of which are inclosed herewith.^a It was adopted by the board of officers appointed by paragraph 14 of Special Orders, No. 52, of 1902, which consisted of Brig. Gen. Robert P. Hughes, U. S. Army; Col. Theodore A. Bingham, Corps of Engineers; Lieut. Col. Thomas H. Barry, assistant adjutant-general, U. S. Army; Lieut. Col. Wm. S. Patten, deputy quartermaster-general, U. S. Army; Lieut. Col. Marion P. Maus, Second Infantry; Lieut. Col. Charles G. Treat, Artillery Corps; Lieut. Col. John Van R. Hoff, Medical Department; Maj. George P. Scriven, Signal Corps; Capt. Joseph T. Dickman, Eighth Cavalry; Capt. Hugh J. Gallagher, Subsistence Department; Capt. Lawson M. Fuller, Ordnance Department.

The sword is intended for both cutting and thrusting purposes, having a sharp point and very slight curvature. It is rather light for a good cutting weapon, and for a perfect thrusting weapon it should be straight. It is in some respects possibly a compromise between lightness and efficiency, and in the last respect is a considerable improvement on the one which it replaced. The board which adopted it had

^a Not printed.

also to consider all other articles of equipment and all articles of uniform, and was thus not only burdened with duties of a widely varied character, but was perhaps not selected as it might have been if the subject of the sword had been its principal consideration; notably there is not known to have been an expert swordsman among the membership. The sword as made has not a very sharp edge; of course, it could be sharpened to any degree, but as it is used with a metal scabbard it is probable that a fine edge would soon be dulled. I am having made a wooden scabbard and also a metal scabbard fitted with a wooden strip upon which it is sought to make the edge of the blade bear, in an effort to produce something which will be serviceable and at the same time will not turn a sharp cutting edge. These scabbards will shortly be ready for examination by anybody which may be directed to consider the subject.

Very respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

26791 O—612-1.

EXHIBIT B.

MEMORANDUM FOR THE SECRETARY OF WAR.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, April 1, 1905.

On receipt of the President's note, dated January 4, quoted on the first page of this report, the Chief of Staff convened a committee to make special inquiry and report on the subject of the bayonet, the inquiry to cover the bayonet in all of its phases as a weapon and article of equipment of a soldier.

This committee does not find the rod bayonet with which our new rifle is furnished as fully answering the purposes of a bayonet. In fact, when adopted, it was known not to be an efficient weapon for hand-to-hand fighting, the general belief being that in modern warfare there is likely to be so little of hand-to-hand conflict as to justify the practical elimination of the bayonet as an instrument of offense or defense.

The reports, official and unofficial, of recent hand-to-hand conflicts in the war in the East have revived consideration of this question, and the possibility, in fact, probability, that in future wars night operations particularly may be forced upon all armies, thus increasing the liability to personal contact, and hence, too, the apparent necessity of a useful bayonet.

I am of the opinion, also, that we should no longer attempt a combination tool, viz, bayonet and intrenching tool, but that we should decide finally that the troops should be furnished with both implements, each efficient for its own purpose and separate and distinct. This the committee recommends.

The bayonet recommended is of the style at present issued to the Army for use with the Krag rifle, differing only in that its length is increased by 6 inches. On examination it is found to be a serviceable bayonet, efficient in every way needful for such a weapon.

The proceedings of this committee were sent to the General Staff in full committee March 28, the Chief of Ordnance and his assistant, Captain Dickson, being also present. The subject of the adoption of the report of the committee was fully discussed and practically a unanimous conclusion arrived at adopting the report.

I concur in the report of the committee and recommend to the Secretary of War that the knife bayonet, 16 inches long, be adopted for issue with the new rifle, and that the Chief of Ordnance be instructed to proceed at once with their manufacture so that as soon as practicable the new rifle may be issued to the Army supplied with the knife bayonet.

The bayonet should not be issued to the cavalry.

The several styles of bayonet mentioned by the committee may be seen by the Secretary of War in the office of the Chief of Staff if he wishes to make a personal examination of same.

Respectfully,

CHAFFEE,
Lieutenant-General, Chief of Staff.

WAR DEPARTMENT,
April 3, 1905.

Approved.

WM. H. TAFT,
Secretary of War.

28791 O—657-5.

REPORT OF A SPECIAL COMMITTEE OF THE GENERAL STAFF IN ACCORDANCE WITH THE FOLLOWING ORDER.

[Memorandum.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, January 25, 1905.

A letter from the President, dated January 4, 1905, together with papers from the Chief of Ordnance relating to the subject mentioned by the President, viz, the length of the new Springfield rifle, the bayonet, and the sword, are herewith referred, for investigation and report, to the following committee of the General Staff: Lieut. Col. Walter S. Schuyler, Capt. Joseph T. Dickman, Capt. Frank DeW. Ramsey, Capt. Frank McIntyre, Capt. Peyton C. March.

By order of the Chief of Staff:

BENJ. ALVORD,
Captain, General Staff, Secretary.

The committee met, pursuant to the foregoing order, at 2.30 p. m., February 3, 1905, all the members being present.

There were laid before the committee the following:

Letter from the President of the United States:

WHITE HOUSE, *Washington, January 4, 1905.*

The SECRETARY OF WAR: I must say that I think that ramrod bayonet about as poor an invention as I ever saw. As you observed, it broke short off as soon as hit with even moderate violence. It would have no moral effect and mighty little physical effect. I think the suggestion of short triangular bayonet a great improvement. After you have gone over this subject of the bayonet and the sword, do take it up with me.

I wish our officers could carry rifles. If they carry any sword, they ought to carry a sword that they can cut or thrust with. Personally I do not see any point in having the cavalry armed with a bayonet, even though the modern cavalryman is nine times out of ten on foot. He might have a sword in his belt, only it ought to be a sword that can do damage.

I am particularly anxious that we should have a thorough test made of the long and the short rifle (that is, of the 24-inch and 30-inch rifle) at some place like that in Utah, where several companies of men can be employed at firing both weapons at long range. This ramrod-bayonet business does not make me feel that we can afford to trust too much to theory of the closet variety. I would like to have the opinion of Captain March, and then the opinion of the other military attachés who saw the fighting between the Russians and Japanese, about both the bayonet and the sword. I would also like to have the opinion of any of our officers in the Philippines who have seen the bayonet actually used.

THEODORE ROOSEVELT.

The following memorandum of the Chief of Staff, dated January 23, 1905:

[Memorandum for General Gillespie.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
January 23, 1905.

Please have this read at the next meeting of the General Staff, with a view to suggesting a committee of five officers to take this matter under consideration and submit report.

The Chief of Ordnance has in preparation, and will present for the inspection and consideration of the General Staff, several different styles of bayonet adapted to the new Springfield rifle. Upon examination of these a complete and careful report will be made upon the suggestion of the President of the United States, taking into consideration also the report of the Chief of Ordnance, herewith, the ideas involved being—

- (a) Shall we adhere to the 24-inch barrel, or have it lengthened to 30 inches?
- (b) Shall we change the style of the bayonet, and if so, what kind should be adopted, and shall it be used in any other way than as a bayonet?
- (c) Is the present saber suitable in every respect, including style and weight, for the service?

Attention is invited to the last paragraph of the report of the Chief of Ordnance, stating that he is preparing a different style of scabbard, with a view to preserving the edge of the sword.

CHAFFER,
Lieutenant-General, Chief of Staff.

A letter from the Chief of Ordnance, dated January 19, 1905, inclosing a memorandum upon the subject of the new rifle, bayonet, and sword, appended, marked "A."

Memorandum of Capt. P. C. March upon use of bayonet and sword in the Russo-Japanese war, dated January 6, 1905, appended, marked "B."^a

Two letters from the Chief of Ordnance, dated January 31, 1905, appended, marked "C" and "D," respectively.^a

The specimens of bayonets submitted by the Chief of Ordnance and described in Appendix C,^a were carefully examined, Capt. T. C. Dickson, Ordnance Department, being present, and explaining in detail the ordnance features of the specimens.

The small triangular rod bayonet fitted to rifle 74724 was broken into several pieces while being tested by a member of the committee. The rifle was held by the stock and the point of the bayonet struck on the floor a moderately hard blow.

^aNot printed.

By direction of the committee, the Ordnance Department was requested to construct bayonets of certain lengths and types, as set forth in the following letter:

FEBRUARY 4, 1905.

SIR: The General Staff committee, of which Lieut. Col. W. S. Schuyler is president, would like to have samples of the new Springfield rifle fitted with: (1) A rod bayonet, similar to those now before the committee, projecting 12 inches beyond muzzle; (2) one projecting 16 inches beyond muzzle, one rod to have three flutes and one four flutes; (3) one rod bayonet 16 inches long, similar to the one fitted to rifle 74733 now in possession of the committee; (4) one knife bayonet projecting 16 inches beyond muzzle; (5) one bolo bayonet on the lines suggested by you yesterday afternoon.

In connection with this subject I desire to inform you that in testing rifle 74724 yesterday with the smaller triangular rod bayonet, I struck the floor a moderately hard blow and the bayonet was shattered into a number of pieces. It is worth while for you to investigate this matter to determine whether it is defective steel or whether the bayonet is not strong enough.

The Board would be glad to receive any suggestions as to improvement in method of fastening the present knife bayonet. It is claimed by some that if this bayonet were used in a hand-to-hand fight, your enemy, grabbing at the muzzle of your gun, would almost naturally take hold of the bayonet at the point where the spring is in the hilt of the bayonet, would press it, and the bayonet would come off.

Respectfully,

P. C. MARCH,
Captain, General Staff, Recorder.

Capt. TRACY C. DICKSON,
Ordnance Department.

Pending the receipt of these specimens the committee adjourned to meet at the call of the President.

MARCH 6, 1905.

The committee met at 2 p. m., all the members being present.

There was submitted to the committee a design for a new bayonet, proposed by Capt. C. B. Humphrey, Twenty-second Infantry, the papers in the case being appended hereto marked "E."^a

Also, an extract from memorandum report No. 26 of the Third Division, General Staff, upon the question of the saber, scabbard, and revolver, appended, marked "F."^a

Also, one knife bayonet with blade 16 inches in length, and one bolo bayonet with a blade 16 inches in length, as set forth in letter from Capt. T. C. Dickson, Ordnance Department, U. S. Army, dated February 14, 1905, appended hereto, marked "G."^a

One triangular bayonet 18 inches long, as set forth in letter from Captain Dickson, dated February 28, 1905, appended, marked "H;" and one bolo bayonet of special design, as set forth in letter dated February 25, 1905, appended, marked "I."^a

The Board, after consideration, determined that the questions referred to it should be taken up in accordance with the following programme:

1. Should the present length of the rifle be changed?
2. Is a bayonet necessary?
3. Should a bayonet be designed for use in any way except as a bayonet?
4. Is the new rod bayonet satisfactory?
5. What type of bayonet should be adopted?

^a Not printed.

The consideration of the subject of the sword was postponed until after the determination of the matters set forth in the above questions.

Pending receipt of other specimens of bayonets under construction by the Ordnance Department, the committee adjourned, to meet at the call of its president.

MARCH 15, 1905.

The committee met, all the members being present.

There were laid before the committee translation of a dispatch from General Kuropatkin, referring to men wounded by bayonet, furnished by the Second Division, General Staff, appended, marked "J;"^a a copy of a dispatch from Colonel Wood, attaché at Tokyo, to the effect that statistics with reference to losses by bayonet would not be furnished by Japan until after the war, appended hereto, marked "K;"^a a letter from Captain Dickson, dated March 14, 1905, with three forms of bayonet, appended, marked "L."^a

All the specimens of bayonets proposed being now before the committee, the consideration of the programme already determined upon was begun.

1. Should the present length of the rifle be changed?

The committee is of the opinion that any further test of the ballistic properties of this weapon would simply be a duplication of the very thorough test of the previous Board; that the only reason for such a change is to give greater reach when the bayonet is used, and not to improve the firing qualities of the gun; that a large number of these rifles have already been constructed, and if there are defects in the gun they will become apparent during the practical tests given it by the Army during its target practice; that the life of the barrel is very limited, and will have to be replaced in a comparatively short time, anyway, when a longer barrel can be constructed, should practical experience dictate such a change.

The committee is therefore of the opinion that the relative importance of the bayonet is not such as to justify abandoning all the guns now constructed, particularly as the shortness of the present gun, plus the bayonet, can be compensated for by increasing the length of the bayonet itself, and that any type of bayonet adopted can be fitted to the present gun at comparatively small cost.

2. Is a bayonet necessary?

The official evidence before the committee of the use of the bayonet in the Russo-Japanese war by both combatants shows conclusively that the bayonet is not a weapon of the past; that the introduction of night attacks on a large scale as a feature of nearly every battle of this war increases its relative importance.

The committee is therefore of the opinion that a bayonet is necessary.

3. Should a bayonet be designed for use in any way except as a bayonet?

After a careful consideration of the advantages claimed for bayonets which combine various other features in addition, such as the saw and file, the bolo, and the entrenching tool, the committee is unanimously of the opinion that the bayonet should be a fighting weapon only. It is either that or it is nothing. The only combination worthy of serious consideration is the one which makes the bayonet also an entrenching tool. This is believed to be a radically faulty proposition. A bayonet

^a Not printed.

used to dig the earth becomes shortly a blunt piece of metal, of little more killing value in hand-to-hand work than the muzzle of the gun would be if lunged into an opponent.

4. Is the new rod bayonet satisfactory?

The Chief of Ordnance in his memorandum herewith states (p. 85):

From this point of view (i. e., the bayonet as a weapon of importance) the rod bayonet fails to meet the requirements, as it is not, and never was thought or intended to be, a thoroughly efficient weapon for purposes of hand-to-hand combat. The question of its use would, therefore, seem to be one which should properly be reopened, and it can be easily changed, and as no issues of the new rifle have yet been made to troops, the subject of the adoption of almost any form of bayonet can be considered without embarrassment.

In addition to the above statement of the Chief of Ordnance concerning the rod bayonet, practical experiment has shown it to be weak and faulty in design as a fighting weapon; and the committee is of the opinion that it is not at all satisfactory for issue to the troops.

5. What type of bayonet should be adopted?

As a corollary of the decision of the committee under (3), i. e., that a bayonet should be designed for use as a bayonet only, the combined bolo, saw, and file submitted by Captain Humphrey, and the bolo bayonets of various designs, but of value primarily as hand weapons, were not considered by the committee as suitable for adoption.

A separate bayonet in the form of a pike, and, like the rod bayonet, a noncutting weapon, was also rejected, as it would necessitate a scabbard, and the principal argument in favor of any form of rod bayonet was its doing away with the necessity for a scabbard, with consequent saving of weight.

The Board considered carefully the various types of rod bayonets before it, and rejected all except the two fitted to rifles 75215 and 93775, described in Appendix L^a herewith, the general objections to the types first submitted being the impossibility of "fixing" the bayonets with sharp-edged triangular points, in action, without cutting the fingers.

The remaining rod bayonets were then carefully weighed, and after mature consideration the one fitted to rifle 93775, having a radius of 0.25 of an inch, and with 4 flutes of uniform depth throughout its entire length, and weighing 9½ ounces, was regarded as the best type of the rod bayonet before the committee.

Pending a decision between this bayonet and the knife bayonet 16 inches long, of the same general shape as the present Krag-Jorgensen bayonet, the committee adjourned to meet Friday, March 17, at 2 p. m.

It having appeared informally that Brig. Gen. George F. Elliott, Commandant, Marine Corps, was desirous of submitting his views upon this subject, a formal invitation to that effect was extended to him by the committee.

MARCH 17, 1905.

The committee met at 2 p. m., all the members being present.

Attention having been directed to the desire of the President to have the views of officers who have served in the Philippines, who have seen the bayonet actually used, it is made of record that all the members of this committee have had service in the Philippines in time of

war: Captains Ramsey and McIntyre in their own arm, the infantry; Lieutenant-Colonel Schuyler, as colonel of the Forty-sixth Infantry, U. S. Volunteers; Captain Dickman, as lieutenant-colonel of the Twenty-sixth Infantry, U. S. Volunteers, and Captain March, as lieutenant-colonel of the Thirty-third Infantry, U. S. Volunteers. All the members of the committee have, therefore, had infantry experience in time of war, without regard to their actual arm of the service.

The arguments submitted in favor of a rod bayonet by Capt. G. H. McMaster, Twenty-fourth Infantry (appended hereto, marked "M"^a), and by Brig. Gen. G. F. Elliott, Commandant, Marine Corps (appended hereto, marked "N"^a) against any bayonet at all, were laid before the committee.

The committee then proceeded to a further consideration of (5) "what type of bayonet should be adopted?" The following reasons were advanced for the adoption of a rod bayonet of the type shown on rifle 93775:

(a) It is a practical thrusting weapon of requisite strength.

(b) It weighs $9\frac{1}{2}$ ounces, against a weight of 18 ounces for the knife bayonet, and avoids the necessity of an additional weight of a bayonet scabbard, estimated at about 10 ounces, a total saving of 19 ounces in weight which must be carried by the soldier.

(c) It avoids the encumbrance of a bayonet scabbard hanging below the belt a total distance of $20\frac{1}{2}$ inches.

(d) It is practicable for issue to all branches of the service.

(e) It allows a hand guard and stock protection for over an inch more of the barrel near the muzzle.

(f) A bayonet stud can be made a part of the upper band for attachment at any time of any special type of bayonet, knife, bolo, or sword, or the attachment of the bayonet now used on the Krag rifle, and of which 500,000 have already been manufactured.

Considering (a) "It is a practical thrusting weapon of requisite strength," it may be stated that a thrust from a rod bayonet may be effective if it happens to strike a vital part, but a knife bayonet, kept sharp, is not only equally effective with the rod bayonet as a thrusting weapon, but in the *mêlée* of night attacks or hand-to-hand work, will cut the hands of an opponent and disable him when the rod bayonet would be ineffective. It can be stated without fear of contradiction, that in the night attack the use of the bayonet is not one of the *finesse* of the fencing school. The rough blows and thrusts of such combats find the knife bayonet a far more suitable fighting weapon than a rod bayonet whose only use must be the thrust.

(b) It is a fact that the rod bayonet weighs less than the knife bayonet of equal length, plus the scabbard. The committee is of the opinion, however, that the last place to save in the weight a soldier has to carry is in his arms and ammunition. The first requisite is to make his weapons as effective for fighting as possible, and from this standpoint the difference in weight of the two types is more than compensated for by the increased general fighting efficiency of the knife type.

(c) The rod bayonet is, of course, carried in the gun itself, which is its scabbard. It is not believed that the bayonet scabbard is fitly described as an "encumbrance." It is simply a convenient means of transporting a necessary weapon. The Japanese, who are very much

^aNot printed.

smaller in size than the average American soldier, carry their bayonets—which are 16 inches long with the infantry, and 24 inches long with the artillery and transport—in a scabbard, without its length apparently interfering with their work in the least.

(d) “The rod bayonet is practicable for issue to all branches of the service.” While recognizing the advantage of a uniform arm for all troops, it is not thought that the utility of the bayonet should be sacrificed to provide for its issue to mounted troops, where it would be of very doubtful value.

(e) “It allows a hand guard and stock protection for over an inch more of the barrel, near the muzzle.” This is a fact, but it is not regarded as of determining value. In fact, where the wooden hand guard can best be spared is at the muzzle.

(f) While it is possible to put a stud on the upper band of a rifle fitted with the rod bayonet, thus providing for two bayonets with the same piece, this is not believed to be desirable from any standpoint. The 500,000 Krag's now in the hands of State troops, etc., would all have to be altered for the rod, while a knife bayonet can be used on these rifles without any change in the method of attachment.

The rod bayonet has one other important disadvantage as compared with the knife type. While it is not desirable to use the bayonet as an intrenching tool, if the worst comes to the worst and it has to be done, the knife can be used for that purpose while the rod can not. The absence of the cutting edge is, too, an essential disadvantage inherent to the rod types.

If it is desired to stack the guns with the knife bayonets fixed, this can easily be effected along the lines of the Japanese, who have the guard of the bayonet curved up in such a way that the “stack” is made by a juncture of these curved parts.

If the knife bayonet is adopted, a ramrod, or cleaning rod, in one piece, can be adopted in place of the jointed rod now furnished in the base of the new rifle. As a matter of practical common sense it is believed that the jointed ramrod would never be used on the firing line. It is too much to expect that, under the conditions of actual combat, a man will screw together the various joints and eject his cartridge shell. What he will do, practically, under those circumstances, may be predicted to be that he will throw away his gun and take one from the nearest wounded or dead man. The one-piece ramrod, possible with the knife bayonet, would do much toward obviating this state of affairs, and is recommended. Furthermore, a one-piece rod could be made of soft metal.

A further and very important disadvantage of the rod bayonet on rifle 93775 is that if bent up slightly, which is possible to be done by the hand, it comes in the path of the bullet. This alone should cause its rejection.

It may be pointed out, also, that of the great military powers of the world, none have a rod bayonet, while most of them, as a result of their experience, have adopted the knife bayonet.

The committee, after mature consideration, therefore, recommends the adoption for the United States magazine rifle, model of 1903, of a knife bayonet in place of the present rod bayonet.

It is recommended that the bayonet be 16 inches in length. This adds the 6 inches to the bayonet, lost by reducing the barrel of the gun from 30 to 24 inches.

It is further recommended that the bayonet be of the type submitted by the Chief of Ordnance, attached to rifle 50909 (267910 O. C. O.; 971668 M. S. O.); the bayonet be carried in a scabbard, which shall be constructed of light material and be free from the rattling incident to the present scabbard. The bayonet to be made of a quality of steel which will take an edge, and to be kept sharp at all times; the front of the blade to be sharpened throughout its entire length, and the back to a length of 5 inches from the point of the blade; the scabbard to be constructed so as to preserve the sharp edge.

If this recommendation is approved, the only change necessary in the Infantry Drill Regulations is to keep the present method of fixing bayonets, with which the troops are already familiar and which is contained in the appendix.

In consideration of the fact that the United States magazine rifle is being held pending a decision upon the points at issue, the committee decided to submit this portion of its report at once, and make the sword the subject of a separate report.

W. S. SCHUYLER,
Lieutenant-Colonel, General Staff.
J. T. DICKMAN,
Captain, General Staff.
FRANK DE W. RAMSEY,
Captain, General Staff.
FRANK MCINTYRE,
Captain, General Staff.
P. C. MARCH,
Captain, General Staff.

[First indorsement.]

MARCH 22, 1905.

To the Chief of Ordnance, requesting remark for the information of the General Staff in full committee at its next meeting, when it is desired also that the Chief of Ordnance and Captain Dickson shall be present, that this matter may be thoroughly discussed at that time.

CHAFFEE,
Lieutenant-General, Chief of Staff.

[Second indorsement.]

OFFICE OF THE CHIEF OF ORDNANCE,
Washington, March 28, 1905.

1. Respectfully returned to the Chief of Staff, United States Army.
2. The following points mentioned in the within report are referred to.
3. The experience thus far had shows that the barrel of the rifle of the model of 1903 shows the effects of wear at from 1,200 to 1,400 rounds, in somewhat diminished accuracy at long ranges, and in an occasional stripping of the bullet.
4. When considering the subject of the weight to be carried by the soldier, no difficulty is found in concurring with the view of the Board that the fighting equipment is the last element in which attempt should be made to save weight; but it is well to bear in mind that weight saved anywhere enables the soldier to carry additional ammunition, at the rate of about 14 rounds to the pound.

5. Whatever conclusion may be reached with reference to the bayonet for the new rifle, the alteration of the Krags already manufactured has not been contemplated.

6. Whether or not there may be considered to exist danger of permanently bending the rod bayonet so that it would be in the path of the bullet, it is extremely probable that the bayonet in its normal extended position would affect somewhat the flight of the bullet.

7. No mention is made in the report of the difficulty which has been reported to have been encountered of withdrawing the knife bayonet from a body into which it may have been plunged; a few distinct statements as to this fault are on file in the Ordnance Office. There seems, however, to have been no mention of it in connection with the experience in Manchuria which has revived the entire subject.

8. The experience of this Department in the equipment of rifles with a metallic cleaning rod, carried under the barrel, has not been satisfactory. It has been difficult to retain the rod in place; it has been said to injure the barrel in use, and the thong is thought to successfully serve its purpose as a cleaner, while with reference to its other objects the opinion of the Board is thought to be sound, that in action the soldier would be much more likely to discard his weapon and pick up an available one than to make use of it. The Ordnance Department would much prefer not to furnish it as an attachment to the rifle.

9. It is presumed that the recommendation of the Board involves the arming of the cavalry with the same gun as the infantry, but without the bayonet. There may be something to be said in favor of the necessity for arming the cavalry with the same weapons which are considered indispensable for the infantry for the circumstances under which it would be expected to do the same kind of fighting; and this may introduce an argument of some force in favor of the rod bayonet for the cavalry arm. But, on the other hand, it may be said that the cavalryman has the revolver for close work, and if the progress of events and opinion lead to the conclusion that the cavalryman should carry something in the way of a bayonet, it will always be possible to issue it to him as adopted, or to furnish him with the short one which has been used with the Krag-Jorgensen rifle.

10. The Ordnance Department will find no inconvenience in issuing the new rifle equipped with the bayonet recommended.

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

APPENDIX II.

PROCEEDINGS OF A BOARD OF OFFICERS CONVENED BY SPECIAL ORDERS, No. 91, OF 1905, TO TEST SIGHTS FOR UNITED STATES MAGAZINE RIFLE, MODEL OF 1903.

ROCK ISLAND ARSENAL,
Rock Island, Ill., May 31, 1905.

SIR. 1. I forward herewith proceedings of the board of officers convened by Special Orders, No. 91, War Department, current series, and in separate package, by express, United States magazine rifle, model 1903, No. 95641, with the model rear sight, raised hand guard, and front-sight cover, which had been approved by the board, and which in their report they recommend for adoption.

2. I am also sending two drawings,^a one showing elevations and the other the plan of the sight proposed by the board. These drawings show the general design only and are not exact as to the final dimensions, elevations of the leaf, the drift curve, or numbering on the leaf, and similar details. Attention is invited to the fact that the top surface of the movable base is slightly inclined downward to the front in order to maintain the correct angle of departure for 400 yards, no matter what may be the position of the slide when the leaf is down.

3. I would remark that neither the sights, as shown on rifle No. 95641, nor the drawings above alluded to could be made very accurate in the limited period which it was believed could be considered available for the deliberations of the board. They should be considered, therefore, merely as indicating the general design recommended by the board rather than absolute models for future constructions.

Respectfully,

S. E. BLUNT,

Lieutenant-Colonel, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE,
United States Army, Washington, D. C.

[First indorsement.]

OFFICE OF THE CHIEF OF ORDNANCE,
Washington, June 10, 1905.

1. Respectfully submitted to The Military Secretary, recommending approval of the general design of rear sight, hand guard, and front-sight cover suggested by the board. United States magazine rifle, model of 1903, No. 95641, to which these articles have been assembled, is forwarded herewith.

2. The following minor changes are deemed advisable, viz:

(a) The tangent screw to be lengthened about 0.1 inch to enable the screw head to be more easily grasped; the end of the screw head will project less than that on the slide and be within the lines of the hand guard. Its diameter should also be slightly enlarged.

(b) The white metal line on the model of 1903 sight met with such general approval as to warrant its application to the new sight without further trial.

3. The issue of an auxiliary leaf for ranges from 2,600 to 3,500 yards does not seem warranted, as small-arms fire is of little value beyond 2,000 yards; at longer ranges the shrapnel fire of field artillery is much more effective.

The issue of sights having different sizes of peep holes does not appear necessary, and is not recommended.

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

^a Not printed.

[Second indorsement.]

JUNE 27, 1905.

Respectfully submitted to the Secretary of War, recommending approval of the proceedings of the board of officers convened by paragraph 1, Special Orders, No. 91, current series, War Department, as modified on the lines suggested by the Chief of Ordnance.

Herewith is a memorandum report of the first division, General Staff, who have carefully reviewed the proceedings of the board and concur in the views of the Chief of Ordnance. The sight recommended is submitted herewith for the inspection of the Secretary of War.

CHAFFEE,

Lieutenant-General, Chief of Staff.

[Third indorsement.]

WAR DEPARTMENT, June 29, 1905.

Approved as recommended by the Chief of Staff in the preceding indorsement.

WM. H. TAFT,

Secretary of War.

26791 Q—736.

Proceedings of a board of officers convened by the following order:

SPECIAL ORDERS, }
No. 91.

WAR DEPARTMENT,
Washington, April 20, 1905.

[Extract.]

1. A board of officers is appointed to meet at Fort Leavenworth, Kans., on Tuesday, May 2, 1905, at 10 o'clock a. m., or as soon thereafter as practicable, for the purpose of testing such designs of sights for the United States magazine rifle, model of 1903, as may be referred to it by the Chief of Ordnance, United States Army.

Detail for the board.—Lieut. Col. Stanhope E. Blunt, Ordnance Department; Capt. John T. Thompson, Ordnance Department; Capt. Walter H. Gordon, Eighteenth Infantry; Capt. Geo. W. Read, Ninth Cavalry; Capt. Peter Murray, Eighteenth Infantry; Capt. Herbert Deakynne, Corps of Engineers, and Capt. Letcher Hardeman, Eleventh Cavalry. Captain Thompson will act as recorder of the board.

The commanding officer of Fort Leavenworth will afford all assistance and facilities required in the conduct of the tests, including the services of such enlisted men as may be requested by the president of the board.

The programme of the tests will be drawn up and the trial conducted and expedited in the most practicable manner, for the purpose of ascertaining which form of sight is most suitable for use in actual service, the relative excellence for target-range work being considered with reference to the training of the soldier to shooting under battle conditions.

The different forms of front-sight protectors will be tested for the purpose of ascertaining which is most suitable for use, particularly by mounted troops.

Upon the completion of the programme the board will submit a report of the tests with recommendations to the Chief of Ordnance. Upon the adjournment of the board the members not stationed at Fort Leavenworth will return to their proper stations. The travel enjoined is necessary for the public service. (1003482 M. S. O.)

* * * * *

By order of the Secretary of War:

ADNA R. CHAFFEE,

Lieutenant-General, Chief of Staff.

Official:

F. C. AINWORTH,
The Military Secretary.

SPECIAL ORDERS, }
No. 95.

WAR DEPARTMENT,
Washington, April 25, 1905.

[Extract.]

* * * * *

5. Capt. Harry LaT. Cavanaugh, Tenth Cavalry, is detailed as a member of the board of officers appointed by paragraph 1, Special Orders, No. 91, April 20, 1905, War Department, to meet at Fort Leavenworth, Kans., for the purpose of testing such designs of sights for the United States magazine rifle, model of 1903, as may be referred to it by the Chief of Ordnance, United States Army, vice Capt. Letcher Har-

deman, Eleventh Cavalry, who is hereby relieved. The travel enjoined is necessary for the public service. (1005463—M. S. O.)

By order of the Secretary of War:

Official:

F. C. AINSWORTH,

The Military Secretary.

GEORGE L. GILLESPIE,
Major-General, Acting Chief of Staff.

FORT LEAVENWORTH, KANS., *May 2, 1905.*

The board met pursuant to the above orders; present, all the members. The above orders and the following letters were then read to the board:

OFFICE OF THE CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C., April 21, 1905.

SIR: 1. I have the honor to transmit herewith a copy of paragraph 1 of Special Orders, No. 91, War Department, dated Washington, April 20, 1905, convening a board of officers, of which you are the president, to meet at Fort Leavenworth, Kans., on Tuesday, May 2, 1905, at 10 a. m., or as soon thereafter as practicable, to test such designs of sights for the United States magazine rifle, model of 1903, as may be referred to the board from this office.

2. A copy of the letter, O. O. file 28791 O—679, by which the convening board was requested, is also inclosed for your information, as it explains the reasons for giving further consideration at this time to the design of sight with which the new rifle should be provided. It is also desired to take advantage of the opportunity thus offered to test different designs of front-sight protectors and muzzle covers, particularly with reference to the form of protection required for preventing the front sight from cutting the rifle scabbard, issued to mounted troops using the rifle.

3. In accordance with the order convening the board, two designs of rear sights, known as models of 1901 and 1902, are submitted for test by it. The commanding officer, Springfield Armory, has been instructed to ship by express to Capt. John T. Thompson, Ordnance Department, recorder of this board, care of the post ordnance officer, Fort Leavenworth, Kans., the following arms and sights for its use, viz:

Three United States magazine rifles, model of 1903, with model of 1901 sights.

Three United States magazine rifles, model of 1903, with model of 1903 sights.

One United States magazine rifle, model of 1903, with model of 1903 sight; the combined upper band and sight stud of which is provided with two lugs for protecting the sight; the form of upper band should not be considered, as the lugs, if desirable, could be made part of the front-sight sleeve.

One Lee rifle of the latest model, adopted by the British Government, which, it will be noted, is equipped with a rear sight similar to the model of 1903 and a front-sight protector of the same design as the above-mentioned rifle.

One rear sight of each of the following models, viz: 1873, 1879, 1884, 1892, 1896, 1898, 1901, 1903, which sights will inform the board of the different designs used in service during the past thirty-two years and the lines along which the two designs submitted for test have been developed.

The commanding officer, Frankford Arsenal, and the commanding officer, Rock Island Arsenal, have been instructed to ship to Captain Thompson 3,000 ball cartridges, model of 1903, and 3 rifle scabbards, model of 1903, respectively, for the use of the board.

4. In addition to the sight protectors on the rifles referred to above, the commanding officer, Springfield Armory, has been instructed to ship the following, viz:

Three front sight and muzzle covers for United States magazine rifle, model of 1903, of the design shown in fig. 109 of the description of the United States magazine rifle, model of 1898.

Three front-sight covers for the United States magazine rifle, model of 1903, of the design shown in fig. 110 of the same descriptive pamphlet.

Three front sight and muzzle covers for the United States magazine rifle, model of 1903, of the design now being made.

Very respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance, U. S. Army.

Lieut. Col. STANHOPE E. BLUNT,
Ordnance Department, U. S. Army.

(President Board of Officers, convened by Special Orders, No. 91, War Department, dated Washington, April 20, 1905.)
(26791 O—691.)

OFFICE OF THE CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C., April 17, 1905.

SIR: 1. The recent adoption of a knife bayonet of increased length for the rifle of the model of 1903, has necessitated a pause in the issue of that rifle to the troops; it is thought best to utilize that pause to give some further consideration to the sight with which the rifle shall be provided. The choice seems to lie between two sights known, respectively, in general terms, as the model of 1901 and the model of 1902. The principal claim of merit for the sight of the model of 1901 is that it has the better peep, and for the model 1902 that the field of view is less obstructed; advocates of both sights claim superior serviceability. The difference in the cost or difficulty of manufacture of the two sights above mentioned is not sufficient to influence a decision as to which is the more suitable. A sight is so much a matter of personal preference that any form adopted is certain to encounter criticism, but it is desired to base a choice upon such judgment as can afterwards be quoted as the best which care and attention to the subject can secure for this department.

2. It is thought that the consideration which should be kept in view is the suitability of the sight for the use in the field for which it is intended, and that relative excellence for target range work should be considered with reference to training of the soldier to shoot under battle conditions which is the object of such work. The board of officers which recommended the adoption of the rifle of the model of 1903 gave due consideration to all of its features, and it can not be said that any new facts in regard to the sight have since been brought forward which would present considerations not before that board. There can be no question as to the skill and judgment and experience of the members of the board, and the only reason for now suggesting a review of its findings lies in the fact that its attention was not specially directed by the convening authority to the sight, and that the conclusion of a large number of officers, upon a matter so difficult to bring under precise rules, would be a better basis upon which to found a decision as to the model which must be reproduced in such large numbers.

3. It is therefore recommended that a board of officers representing all branches of the service concerned with the sight be assembled at such point as may present suitable facilities for trials, and where there may be a number of enlisted men available for practice under the direction of the board, with instructions to recommend the form of sight, among those submitted by the Ordnance Department, which is best suited for adoption for use in the service on the rifle of the model of 1903.

4. It is also suggested that the board consider different forms of protectors for the front sight, particularly for rifles issued to the cavalry which are to be carried in scabbards.

* * * * *

WILLIAM CROZIER,

Brigadier-General, Chief of Ordnance, U. S. Army.

The MILITARY SECRETARY, U. S. ARMY.

26791 O—679.

OFFICE OF THE CHIEF OF ORDNANCE,
Washington, April 24, 1905.

SIR: 1. Referring to letter from this Office dated April 21, 1905, O. O. file 26791 O—691, in which you were informed in regard to the models of sights and different sight protectors which are to be tested by the board, I have the honor to send you inclosed herewith, for the information of the board, all of the criticisms on file in this Office relating to the two designs of rear sights to be tested by it, namely: O. O. files 37927—49, 35825—39, 37927—39, 35979—53 with inclosure 1, 16964—153, 16964—191, 25109—23, 25301—369, 28487—20, 31627—712 with inclosure 1, 28487—21, 37329—15 with inclosure 1, 30496—409, 30496—403, 30843—250, and 31149 O—24 with inclosures 2, 3, and 4; also the reports submitted by the individual members of the board of officers convened by Special Orders, No. 19, Headquarters of the Army, Adjutant-General's Office, Washington, January 23, 1903, which board recommended the adoption of the United States magazine rifle, model of 1903, and the model of 1903 sight, namely: O. O. files 26791 O—185 with inclosures 1 to 10, inclusive, 26791 O—167, 26791 O—183 with inclosure 1, 26791 O—168 with inclosure 1.

Upon the adjournment of the board all of these papers should be returned to this Office.

2. You are also instructed to obtain from the commanding officer of Rock Island Arsenal, for the use of the board, O. O. file 38660—76, which is the report of Capt.

George Montgomery, Ordnance Department, United States Army, in connection with his duties at the maneuvers at Manassas, Va., referred to the commanding officer of Rock Island Arsenal by fourth indorsement, dated January 10, 1905. Upon the adjournment of the board this paper should be returned to the commanding officer of Rock Island Arsenal.

Respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

Lieut. Col. STANHOPE E. BLUNT,
Ordnance Department, U. S. Army, Rock Island Arsenal.

(President Board of Officers, convened by Special Orders, No. 91, War Department, 1905.)

26791 O—697.

The board then entered into a discussion of the provisions of the orders convening it, of the nature of the duties devolved upon it, and of the appropriate methods of procedure. After further discussion, the board adopted the following programme of tests, to be modified as circumstances might necessitate:

PROGRAMME OF TESTS.

1. An examination of the various reports from line and Ordnance officers, submitted to the board by the Chief of Ordnance, and the compilation of the comments therein on the sights, giving in every case the name of the officer and date of report.

2. A critical examination of each sight as to general design and of each component thereof, in order to determine whether it is amply strong and properly designed for its purpose, by each member of the board.

3. A consideration of the essential features of a sight "for use in actual service, the relative excellence for target range work being considered with reference to the training of the soldier to shooting under battle conditions." What features are desirable? What preferable? Particular consideration to be given to any essential feature not possessed by either sight.

4. Firing tests. Since the courses in target range work given in the Firing Regulations for Small Arms, 1904, embody the experience of the Army in the final step of increasing the soldier's accuracy of fire in action, the test of each sight will consist in firing through the record portion of the marksman's course by marksmen, first-class men, second-class men, third-class men, and unclassified men, selected for each class from the infantry, cavalry, and engineers; similarly for the sharpshooter's course and expert rifleman's test.

Expert firing by the distinguished marksmen will also be had. At the conclusion of the firing, each firer will name his preference, and give reasons therefor, to the board. Each member of the board will do such firing as he may deem necessary to form his opinion as to the relative merits of the sights.

5. The sights will be exhibited to such officers, expert riflemen, sharpshooters, and marksmen of the various organizations serving at Fort Leavenworth as may desire to see them, and the opinion thereof considered by the board.

6. Rifles with each sight will be tested in rapid mounting by cavalymen at the conclusion of the firing test.

7. A final consideration of the sights under test as to features deemed essential, preferable, and desirable.

8. The different kinds of front sight protection submitted to the board will be practically tested to determine which is most suitable for use, particularly for mounted use.

9. Findings and recommendations.

In accordance with the provisions of paragraph 1 of the programme, the various criticisms of the models of 1901 and 1903 sights contained in the letters and reports submitted to the board by the Chief of Ordnance (O. O. file 26791 O—697) were read and carefully considered by the board. A compilation of the portions of these papers relating to the sights is appended and marked "A."^a

At 6 p. m. the board adjourned until 9 a. m., the 3d instant.

FORT LEAVENWORTH, KANS., *May 3, 1905.*

The board met pursuant to adjournment. Present, all the members. The board then examined the following rifles, rear sights, and forms of front-sight protectors received from Springfield Armory.

One Lee-Enfield rifle "S 4765."

Eight United States magazine rifles, model of 1903:

No. 76419—combined front band and sight protector.

No. 76762—front band and front-sight sleeve combined.

No. 96479 } modification of 1901 sight (windage screw).

No. 48363 }

No. 99725 } model of 1903 sight, with peep plate.

No. 95698 }

No. 78565 }

No. 95641—front band, correct size and form.

NOTE.—The other front bands are not exactly right.

Three front-sight covers, carbine, caliber .30, modified for model of 1903 rifle.

One front-sight and muzzle cover.

Three front-sight and muzzle covers, model 1898, modified for model of 1903 rifle.

Nine rear sights, complete (one each models of 1878, 1884, 1892, 1896, 1901, 1903, and two model of 1879).

One rear-sight model of 1901 on base sleeve.

A letter dated April 26, 1905, from Col. Frank H. Phipps, Ordnance Department, commanding Springfield Armory, to Lieut. Col. Stanhope E. Blunt, Ordnance Department, president of the board, stating that the limited time allowed had not permitted the graduation of the modified model of 1901 sights for the model of 1903 rifle, was then read.

In accordance with the provisions of paragraph 2 of the programme of tests, each member of the board made a critical examination of the modified model of 1901 rear sight and of the model of 1903 rear sight, examining also the different components which had been dismounted for this purpose. The various models of sights received from Springfield Armory were carefully examined.

In accordance with the provisions of paragraph 3 of the programme, the board then considered the essential features of a sight "for use in actual service, the relative excellence for target-range work being considered with reference to the training of the soldier for shooting under battle conditions." Besides the usual requirements that a service sight must be simple, strong, and compact, the board deems the following features essential to a sight satisfying the conditions above quoted:

1. A good peep sight as well as the usual open sight on account of the general use of a peep for firing at the longer ranges.

2. A wind-gauge arrangement which will give constant angular correction for each point on wind-gauge graduation, irrespective of elevation.

^a Not printed.

3. A leaf which will readily fold completely back upon the barrel or receiver, thus preventing its being injured or broken if inserted, when raised in the rifle scabbard.

The following features are considered preferable:

1. A movement of the sight in azimuth by means of a screw, giving minute windage corrections or larger changes without removal of the rifle from the shoulder to a binding lever and movement by hand.

2. A windage screw with head on right side of rifle to one with head on left side, as it more readily permits of manipulation without removal of rifle from shoulder.

3. A sight in which any error in setting the leaf slide for elevation is not multiplied, to one in which such error is multiplied.

4. A peep which does not change at different elevations its form as viewed by the firer to one which does.

5. A U-shaped open notch to a V-shaped one.

6. For the protection of the rear sight, a projection of the wooden hand guard directly in front of the rear sight, to a metal band, raised on top, placed at that point.

The following features were considered desirable:

1. An extensive field of view.

2. Sufficient metal above and below peep to prevent blurring. The members of the board noted the very small changes of elevation of the model of 1903 rifle for the ordinary fighting ranges and its large maximum continuous dangerous space of about 500 yards against infantry (when gun is fired from shoulder of soldier standing, with 400 yards elevation and at middle point of a target or man, 68 inches high).

The president of the board stated that he had requested from the commanding officer of Fort Leavenworth the use of the target range and the services of officers and enlisted men to carry out the firing tests, and that these requests had been granted.

The board at 12 o'clock took a recess to meet at 1.30 p. m. on the Fort Leavenworth target range for the purpose of conducting the firing tests, as prescribed in paragraph 4 of the programme.

At the range Lieut. C. W. Cole, Ninth Cavalry, and Sergts. J. W. Spicer, Company B, Eighteenth Infantry, C. Mika, Company D, Eighteenth Infantry, and S. Thomas, Troop G, Ninth Cavalry, having been detailed by the commanding officer, Fort Leavenworth, reported for duty and remained with the board until May 6, each firing at least one score with the open and peep notches of both 1901 (modified) and 1903 sights at all the prescribed ranges up to 1,000 yards, and participating in the skirmish firing. Corporal Randolph, Company B, First Battalion of Engineers, performed like duty for the board. As two companies of the First Battalion of Engineers were in camp and firing on the range a number of officers and enlisted men of various qualifications as to marksmanship fired from time to time at the various ranges, as did also some of the officers and men serving at Fort Leavenworth. The members of the board fired from time to time at all ranges. Upon completion of each firer's score he was asked by the board his preference as to the sights, his reasons therefor, and requested to make any criticisms and recommendations on the subject deemed necessary. At the close of each half day's firing this information was duly considered by the board. Important points or defects developed were considered at once by board on the field.

As the modified model of 1901 sights had not been graduated for the model of 1903 rifle, and as the model of 1903 sights were used for

this first time by some of the firers, the scores made are not appended, the purpose of the firing being to secure the opinions of the firers as to the best form of rear sight satisfying the conditions given by the order convening the board. During the afternoon slow firing at 200 and 300 yards was conducted. At 6 p. m. the board adjourned until 9 a. m., the 4th instant.

FORT LEAVENWORTH, KANS., *May 4, 1905.*

The board met pursuant to adjournment. During the morning session slow firing at 500 and 600 yards and during the afternoon session at 800 yards was carried on with the various rifles and sights under conditions previously mentioned. During the firing the peep plate on model of 1903 sight on one of the rifles worked loose, so that it would not retain its position up or down. Lieut. Charles R. Pettis, Corps of Engineers, submitted a letter containing recommendations as to sights, which is appended and marked "B."^a

Pursuant to the provisions of paragraph 5 of the programme, the models of 1903 and 1901 (modified) sights were shown at various times in the board room and on the target range to a number of officers and enlisted men, some of whom participated in the firing. Their opinions were duly considered by the board.

At the close of the afternoon session the board, pursuant to the provisions of paragraph 7 of the programme, duly considered the results of its investigations and of the firings up to date and after extended discussion decided—

First. That neither the model of 1903 nor the modified model of 1901 rear sights satisfy the essential conditions for a sight "suitable for use in actual service, the relative excellence for target-range work being considered with reference to the training of the soldier to shooting under battle conditions."

The general design of the model of 1903 sight does not lend itself readily to the attachment of a good strong peep. The peep plate on this sight is attached by a small screw to a thin portion of the eyepiece and is apt to work loose. If the leaf be raised for setting the slide, the peep plate pushed up and the leaf permitted to snap down on the base, the peep plate is apt to jar down into its lower position. The amount of metal around the top of the peephole is so small that the metal is scarcely visible at the longer ranges, where most used. The peephole appears elliptical and blurs somewhat at all ranges, except 500 yards. The model of 1903 rear sight does, therefore, not satisfy the first essential condition laid down by the board, but does satisfy the second condition.

The modified model of 1901 rear sight satisfies the condition of a good peep at all ranges, but is considered defective as to the second condition, as it requires the use of the leaf down for an open sight up to about 500 yards. As the slide is moved forward in this position of the leaf the open notch thereon approaches the center of rotation of the movable base, and hence its wind gauge does not give constant angular correction for each point irrespective of elevation.

Neither model of sight satisfies the third condition as to bedding back down on the barrel if inserted with the leaf raised into the rifle scabbard. The form of the model of 1903 sight apparently does not admit of a modification permitting such a movement.

^a Not printed.

As the form of the modified 1901 rear sight admitted of further modifications satisfying the essential conditions as to constant angular windage corrections and folding back on barrel, and hence all the essential conditions, the board recommended that the following changes be made therein:

The open sight or leaf down to give in all forward positions of slide an elevation of 400 yards corresponding to the battle range, thus utilizing the straight trajectory of the model of 1903 rifle.

This requires the ears at rear end of movable base to be raised, so that, in connection with an increase in the length of drift slide due to the insertion of an open sight therein (in shape like that in sliding leaf of 1884 sight) above the peep, the leaf can be thrown fully back on barrel, the top of open sight resting on top of receiver in most positions of slide on the leaf. The open sight on drift slide can be used from 100 yards up to near 1,800 yards as can the peep. From 1,800 yards to 2,500 yards (which latter graduation can be obtained on the 1901 leaf, very slightly lengthened, on account of the higher velocity and shorter sight radius of the 1903 rifle) the open notch on the top of the slide must be used.

The inside of the leaf (like the 1901 leaf for rifle) should be provided with an automatic drift correction curve as far as practicable.

The top of the leaf should be bright and the figures and lines dark as in the model of 1901 sight.

The board liked the addition of the strong tangent screw to the model 1901 sight, and the position of head on right side, but recommends that the diameter of the head, if found practicable, be somewhat increased.

Protection of rear sight should be given by a swell on the rear end and top of hand guard.

The outer left side of the leaf should be roughened by cross lines to prevent slipping of the slide when slide screw is tightened.

The base, the movable base, and the leaf should each be made wider in order to give a less obstructed field of view and the sides of the leaf broadened so as to strengthen this part of the sight.

The leaf should be slightly lengthened so as to be more readily raised by the finger from the front end and to admit of the 2,500 yards graduation.

The U-shaped open sights on the model 1901 sight were considered satisfactory.

Peep sights with holes of 0.04, 0.045, 0.05, 0.055, and 0.06 of an inch, were desired for trial.

The board, believing it desirable to test a sight of the general design of the model 1901 sight, but so modified as to embody its conclusions as above expressed, then decided to send the following telegrams:

FORT LEAVENWORTH, KANS., May 4, 1905.

THE MILITARY SECRETARY, Washington, D. C.:

Board does not approve any sight tested. Recommends alterations that can be made at Rock Island Arsenal and that board now adjourn and return to stations to meet on completion about May 23, or earlier, at call of president.

BLUNT.

CHIEF OF ORDNANCE, U. S. ARMY, Washington, D. C.:

Board has recommended adjournment to meet again upon completion at Rock Island Arsenal of changes they desire in sight.

BLUNT.

At 6.30 p. m. the board adjourned until 9 a. m., the 5th instant.

FORT LEAVENWORTH, KANS., *May 5, 1905.*

The board met pursuant to adjournment; present, all the members. Rapid firing at 200, 300, and 500 yards was carried on during the morning session and slow fire at 1,000 yards during the afternoon session under usual conditions. The 1901 sight slide was criticised for not remaining fixed at times after much use. The 1903 peep was criticised as giving a blurred effect at 1,000 yards. The good field of view of the 1903 open sight was commented upon.

The board adjourned at 6 p. m. to meet at 9 a. m., the 6th instant.

FORT LEAVENWORTH, KANS., *May 6, 1905.*

The board met pursuant to adjournment; present, all the members. Several skirmish runs were made by members of the board, the selected marksmen, and other officers and enlisted men.

Three mounted cavalymen reported to the board for trial of front-sight protectors. The different forms before the board were fixed to the rifles, which were repeatedly drawn from and returned to new rifle scabbard. The cavalymen, with the different forms (both permanent and detachable) on rifles placed in scabbards, galloped for some time. The results were examined as to bending the protector or front sight and as to cutting the scabbards.

The board decided from test of the rifle so altered that no permanent front-sight protection was desirable, as it interfered with the light on front sight during firing, as the ears on sides were apt to be taken, especially in rapid firing, for the front sight (although it was realized that this action on part of firer is somewhat due to his want of familiarity with the use of a rifle provided with such a protector), and as it was heavy and unsightly.

The board does not consider any muzzle cover necessary.

The board recommends the adoption of the front-sight cover for the caliber .30 carbine, modified for model of 1903 rifle. This cover should be retained on the rifle when in scabbard. Experience shows that this form of protector will give ample protection to the front sight when rifle is in or out of scabbard, and will also protect the scabbard from wear or cutting by the front sight.

The following telegram to the president of the board was received:

Order made directing members of board to test design rifle sights to return to proper stations and to reconvene at Fort Leavenworth at call of president of board.

McCain,
Military Secretary.

The board then, at 5 p. m., adjourned, to meet at the call of the president.

JOHN T. THOMPSON,
Captain, Ordnance Department,
U. S. Army, Recorder.

FORT LEAVENWORTH, KANS., *May 23, 1905.*

The board met, present all the members, pursuant to call of the president, as authorized by the following order, and continued its daily sessions until final adjournment:

SPECIAL ORDERS, }
No. 105. }

WAR DEPARTMENT,
Washington, May 6, 1905.

(Extract.)

* * * * *

9. The members of the board of officers appointed by paragraph 1, Special Orders, No. 91, April 20, 1905, War Department, will return to their proper stations for duty,

and the board will reconvene at Fort Leavenworth, Kans., at the call of the president of the board. The travel enjoined is necessary for the public service.

* * * * *
By order of the Secretary of War.

GEORGE L. GILLSPIE,
Major General, Acting Chief of Staff.

Official:

F. C. AINSWORTH,
The Military Secretary.

The board then considered a letter from Capt. N. F. McClure, quartermaster Fifth Cavalry, dated Fort Huachuca, Ariz., May 2, 1905, recommending a wind-gauge sight that will change uniformly and suggesting that this defect may be obviated in the 1901 model sight by always shooting with the leaf raised. He also suggests that the sight be simple, does not think a peep sight of much advantage, but, at critical point, it might be a cause of confusion, mentions that on present carbine the sight can be fixed for certain ranges in three different ways, making the sight too complicated for the average soldier.

In letter to president of the board, dated Fort Huachuca, Ariz., May 14, 1905, Capt. N. F. McClure, quartermaster Fifth Cavalry, acknowledges the receipt of a reply dated 9th instant and states:

My main reason for objection to the peep sight is the danger of confusion in excitement of battle, etc. The simplest sight ought to be the best. Since I wrote to you, however, I have been using the peep sight in my regular range practice and with such good results that I must confess that I have been won over and now have no objection to its being put on our new sight.

The board then considered the following letter and indorsement:

SPRINGFIELD ARMORY, MASS., *May 5, 1905.*

Sir: 1. I am forwarding you to-night by express a model of 1903 rifle with new front band and sight protector, which, if it meets the approval of the Department, I should be glad to have submitted to the board at session at Fort Leavenworth. It will be noted that the front band was made from an old band, as shown by the brazing, but it represents in outline the front band, which has been recommended.

2. The front sight, it will be observed, is an adjustable sight, and should the protecting ears be adopted it would do away with the necessity of pinning the front-sight stud to the front-sight band and would also obviate the necessity of a front-sight protector. Blueprints of this protector are inclosed.^a

3. The holes in the sides of the protecting ears permit of a ready adjustment of the front sight, and forwarded herewith is a brass set, which can be used with this gun.

Respectfully,

FRANK H. PHIPPS,
Colonel, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

26791 O—71C

[First indorsement.]

• OFFICE OF THE CHIEF OF ORDNANCE,
Washington, May 10, 1905.

1. Respectfully forwarded to Col. Stanhope E. Blunt, Ordnance Department, United States Army, president of the board convened by Special Orders, No. 91, War Department, April 20, 1905, with request that the front-sight protector on United States magazine rifle, model of 1903, No. 83000, be tested in connection with those referred to in O. O. file 26791 O—691, dated April 21, 1905. The rifle in question has been sent him at Rock Island Arsenal by express this date.

2. His attention is invited to the liability of one of the sides of the protector being, in case of excitement, used instead of the front sight. It should also be noted that the front sight is retained in its correct position only by friction.

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

^a Not printed.

United States magazine rifle, model of 1903, No. 83000, with front band and sight protection, was then carefully examined by the board, which adhered to its former opinion against the use of a permanent front-sight protection. The board further recommends no change in the form, thickness, or size of the front sight proper.

The board then examined three modified 1901 rear sights as further modified at Rock Island Arsenal to meet its views, as previously expressed in these proceedings. These sights are of the same design and have widths of base of 0.70, 0.80, and 0.90 inch, respectively. The width of the leaf and of its sides has been increased proportionately in each case. These sights should be regarded as showing mainly the design of sight desired and as only approximately establishing the final dimensions, the position of the graduations on the leaf, and the form of the drift curve. The limited time for the modifications did not permit of doing anything more than this, or of the production of working drawings.

The three rifles with proposed sights, hand guards, and front-sight protectors were then returned to and drawn many times from the rifle scabbards of present model, and also from scabbards recently altered at Rock Island Arsenal to conform more correctly to the rifle with modified 1901 sight. The board found that protection for the rear sight is not fully provided by the present model of scabbard, and if the modified 1901 sight—the raised hand guard and front-sight protector—be adopted, the present model of scabbard for the model of 1903 rifle will require modification. The experimental scabbards, however, showed that this form of sight can be properly protected by some form of scabbard.

The board found that the sight having a width of base of 0.70 inch was amply strong for service, and that with any greater width of base there would be a strong probability of the slide screw projecting so far as to catch in any practicable form of rifle scabbard, resulting in injury to the leaf.

The board then proceeded to the target range and fired the rifle provided with the 0.70-inch width sight, slow and rapid fire. The results were satisfactory.

The board recommends a peep hole of 0.050-inch diameter, as that size of hole was found to give the most satisfactory results at all ranges, and also a strictly U-shaped open notch 0.045-inch wide by 0.0325-inch deep. The above dimensions for both sights are understood to be exactly those determined at Springfield Armory after extensive experimental firings, supported by all firings at the armory since that time. The board also recommends that two drift slides, with peep holes of 0.040-inch diameter and two with peep holes of 0.060-inch diameter, be issued in each arm chest of ten rifles, and that drift slides, with peep holes of any diameter required, be issued on special requisition. The board further recommends that some drift slides with lines of white metal, as on the model of 1903 sight, placed under the open notch and peep hole but terminating at 0.05-inch therefrom in each case, be issued for trial.

The board recommends that the open notch be placed at the base of a triangular opening in the drift slide above the peep, arranged in the manner modified at Rock Island Arsenal, in accordance with its directions. This combination of peep and open sight provides a sight which will be used at all ranges with the leaf vertical, permits use of a peep

sight for ranges from 100 yards to 2,000 yards, inclusive, and for an open sight in the drift slide above the peep for all ranges from 100 yards to 2,100 yards, inclusive; for other ranges up to 2,400 yards an open sight is provided by a notch on the top of the drift slide, and for a range of 2,500 yards by a notch on the upper cross arm of the leaf.

With the leaf turned down upon the movable base, the open notch on the face (or cap) of the slide corresponds for any position of the slide along the leaf up to 2,200 yards to a range of 400 yards, and would therefore be suitable for battle conditions at the shorter ranges without any adjustment.

The sight also affords automatic correction for drift with the leaf raised and a correction for 400 yards with the leaf down, and a wind gauge in which the actual correction is constant for all adjustments of the sight with the leaf raised.

The sight is also so constructed that the leaf can be folded back horizontally upon the receiver.

In order to secure the advantage of volley fire at longer ranges than the leaf is graduated, the board recommends the issue of a number of slides graduated from 2,600 to 3,500 yards, if practicable.

These slides should be made to slip into the undercuts inside the leaf and should be attached to the latter by a suitable clamping device. Such an addition to the sight would enable trained infantry to use indirect fire at these extreme ranges.

After mature deliberation the board finds that the rear sight on the United States magazine rifle, model of 1903, caliber .30, No. 95641, Springfield Armory, with width of base of 0.70 inch protected by the raised hand guard thereon, embodies the changes ordered by the board, in the modified model of 1901 sight, submitted to the board by the Chief of Ordnance, United States Army, and provides a sight with the features above enumerated, and that, as thus modified, this "form of sight is most suitable for use in actual service, the relative excellence for target-range work being considered with reference to the training of the soldier to shooting under battle conditions."

The board therefore recommends the adoption of this sight for use on the United States magazine rifle, model of 1903.

There being no further business before it, the board then, at 4 o'clock p. m., May 24, 1905, adjourned sine die.

S. E. BLUNT,

Lieutenant-Colonel, Ordnance Department, President.

JNO. T. THOMPSON,

Captain, Ordnance Department, Recorder.

W. H. GORDON,

Captain and Adjutant, Eighteenth Infantry.

G. W. READ,

Captain, Ninth Cavalry.

PETER MURRAY,

Captain, Eighteenth Infantry.

HERBERT DEAKYNE,

Captain, Corps of Engineers.

H. LA T. CAVENAUGH,

Captain, Tenth Cavalry.

APPENDIX III.

TEST TO DETERMINE CAUSE OF LOSS IN ACCURACY PRODUCED BY EROSION OF CALIBER .30 RIFLE BARRELS.

(5 plates.)

ACCURACY OF THE MODEL OF 1903 RIFLE.

1. Careful comparative erosion and accuracy tests of two model of 1903 rifles show that while the accuracy, as represented by the mean radius of the circle of shots, is approximately 9 inches at 1,000 yards, using either the fixed or muzzle rest, there is an appreciable falling off in accuracy at 2,000 rounds, the mean radius increasing to approximately 13.5 inches. A rifle fired 2,000 rounds will therefore be considered unsuitable for accurate target work. From this point the accuracy falls off more rapidly, and at 4,500 rounds, if not before, the suitability of the rifle for even active service will certainly be questioned, as the mean radius becomes approximately 26 inches, and about 20 per cent of the bullets fail to reach the target. After 5,000 rounds the average mean radius with one rifle was 38.3 inches, and it was practically impossible to obtain a target with the other.

2. It should be noted that in firing the intermediate rounds in these tests magazine fire was employed and that in cooling the bore after each 25 shots the temperature was sufficient to boil the water. These erosion tests, as conducted at Springfield Armory, represent therefore the most severe conditions that could exist in service.

EFFECT OF METALLIC DEPOSIT.

3. The first of the experiments undertaken to determine, if possible, the causes of this marked falling off in accuracy was to determine the effect, if any, upon the accuracy of the deposit made by the bullet during its passage in the bore. In view of the minuteness of this metallic deposit and the difficulty of removing it, the investigations were limited to determining the effect of this deposit by finding the force required to drive three service bullets through the bore when new and three bullets after 3,500 rounds had been fired. In cleaning the barrels during and after the firing, soda water, oil, and rags were used, but no brushes of any kind.

DEPOSIT BARREL NO. 1.

4. Plate 1 gives the plotted values of the force required to force the six bullets through deposit barrel No. 1, as determined at Watertown Arsenal. The apparatus consisted of a piston or rod 0.2950 of an inch

in diameter, 0.005 of an inch less than that of the bore, acting against the base of the bullet and having an adjustable load applied at the other end. An endeavor was made to maintain a uniform velocity of the bullet of about 1 inch per minute, but this was found impracticable, the velocity varying from 0.04 of an inch to 3 inches per minute. When the barrel was new the maximum force required was 1,267 pounds, and the three broken lines are very uniform. After the barrel had been fired 3,500 rounds the force required was considerably greater, rising to 4,300 pounds with the first bullet. The first and third bullets are shown on pl. 3, B-1 and B-2. The following may be stated of these three bullets, the quotation marks indicating extracts from the report of the commanding officer, Watertown Arsenal:

First bullet after firing: "The head was forced through the jacket of the metal, the conical point being detached from the cylindrical part of the jacket. The rear part of the jacket fell behind the base of the lead core a distance of one-fourth inch on one side of the bullet, and apparently got between the piston and the walls of the barrel, thereby increasing the frictional resistance." This evidently occurred in the second inch of travel, resulting in the maximum resistance of 4,350 pounds.

Second bullet after firing: "The bullet entered freely to a place where its base was five-eighths inch beyond the forward end of the cartridge case." There was a flowing back of the jacket metal beyond the base of the lead core, and it is possible that this metal, getting between the piston and walls of the barrel, was partly responsible for the maximum force rising to 2,430 pounds.

Third bullet after firing: "Bullet showed marks of the rifling for a length of 0.95 to 1 inch. The conical point of the jacket was ruptured circumferentially about 0.8 inch around the body. The metal of the jacket at the base of the bullet flowed over the end of the piston, 0.05 inch maximum length of the thin fin." The maximum force was 3,220 pounds.

5. As the star gauge for caliber .30 rifles had not been completed when this test was commenced, the bore was star-gauged at the end of the test only. The measurements showed that the diameter of the lands for a distance of 12 inches from the muzzle, and of the grooves for a distance of 20 inches from the muzzle (total length of rifling 21.25 inches), were yet within the limits permitted in manufacture. At 21 inches from the muzzle the diameter of the lands and grooves was 0.0038 and 0.0008 of an inch, respectively, greater than the maximum permitted.

DEPOSIT BARREL NO. 2.

6. Owing to the incomplete and unsatisfactory data obtained from the above barrel, a second barrel was taken from the regular stock of Westmoreland steel, lot 11, for a continuance of these experiments. The lands and grooves were star-gauged and the barrel fired for velocity and for accuracy at 500 yards. After 3,500 rounds, the star-gauge measurements of the lands and grooves were again taken and the firings for velocity and accuracy repeated. The star-gauge measurements showed, after 3,500 rounds, no appreciable change in the bore for a distance of 12 inches from the muzzle. At that point the enlargement was 0.0001 inch and increased to 0.0058 inch at 21 inches. The grooves showed less change, the measurements agreeing

with those made when the barrel was new for a distance of 19 inches from the muzzle. At 20 inches, however, the enlargement was 0.0005 inch and at 21 inches 0.0065 inch. The muzzle velocity had fallen off 100 feet per second and the accuracy (mean of 5 targets of 10 shots each at 500 yards), as represented by the mean radius of the circle of shots, had decreased from 4.2 inches to 6.3 inches.

7. Plate 2 contains the plotted value of the force required to force service bullets through the bore of deposit barrel No. 2, as determined also at Watertown Arsenal. The bullets forced through after 3,500 rounds do not show the stretching and rupturing of the jacket metal as was the case with the bullets forced through deposit barrel No. 1 after the same number of rounds; neither do the broken lines on pl. 2 show the excessive resistance of those on pl. 1.

INTERPRETATION OF THE RESULTS OBTAINED.

8. With barrel No. 1 (before firing), the force required varied from 0 to 1,260 pounds, and was practically the same for all three bullets, the maximum resistance occurring at the end of about the first half-inch of travel, as was to be expected. With barrel No. 2 (before firing), the force required varied from 0 to 1,600 pounds, the maximum resistance occurring, for the three bullets, at the end of 3.5, 12.6, and 14 inches of travel respectively. The star-gauge measurements failed to indicate any cause for the great difference in the positions of the points of maximum resistance, and no reasonable explanation suggests itself.

9. With barrel No. 1, after 3,500 rounds, the broken lines, pl. 1, show a great variation in the force required, which varied from 0 to 4,350 pounds, the maximum resistance being encountered for the three bullets after 1.5, 20.1, and 10 inches length of travel, respectively. With the first bullet it is possible that in the enlarged cavity made by the erosion the bullet wedged in the rough and eroded part, rupturing the jacket metal, which flowing to the rear of the lead core, caught between the piston and the walls of the barrel, thereby increasing the frictional resistance. It is evident from the low force required that the second and third bullets encountered no such resistance over the eroded part, and that they reached a point beyond before the frictional resistance became great enough to lead to yielding of the jacket metal. The metal of the second bullet yielded slightly, but that of the third bullet materially. Neither the star-gauge measurements nor the sectioned portions of the barrel indicate any cause for the great frictional resistance encountered by these bullets after passing the eroded part, and it is believed that it was unquestionably due to other causes than the deposit.

10. With barrel No. 2, after firing 3,500 rounds, the force required was practically the same for all three bullets. It increased gradually until the bullets were beyond the badly eroded part of the barrel and was at its maximum where the bore and lands have their least diameters. The curves therefore agree very closely with the deductions to be made from the star-gauge measurements which show that for all points along the bore the erosion and wear are greater than the deposit.

11. In conclusion, therefore, it may be said that while the accuracy after 3,500 rounds falls off, nothing in the experiments made indicate

that the slight deposit which can not be removed with the usual appliances in the hands of the troops, could be, even to a slight extent, the cause of this decrease.

EFFECT OF EROSION.

12. The results of the above experiments not only demonstrated that the metallic deposit has no appreciable effect upon the accuracy, but the star gauge measurements and the examination of the sectioned barrels revealed no change in the bore from any cause for a distance of from 15 to 17 inches from the muzzle that could have any appreciable effect upon the accuracy. It was plainly evident from the condition of that part of the barrel and from recovered bullets that the bullets left the muzzle with a rotational velocity decreased only by the decrease in the muzzle velocity. This decrease in muzzle velocity, due to a portion of the gases escaping around the bullet and the bullets being farther forward when they encounter the maximum resistance, would not, however, appreciably affect the accuracy.

13. It was necessary to look in rear of this section for the causes of the falling off in accuracy. In the examination of the bullets forced through deposit barrel No. 1, it was observed that the axis of the conical point of the bullets is no longer parallel to the axis of the cylindrical part, and it was thought that this warping of the longitudinal axis may have been due to the bullet wedging as it took its seat in the rifling in the eroded barrel. Whatever the cause it was inferred from the appearance of these bullets that this warping probably occurred in firing also and would, if sufficiently great, account for the falling out in accuracy.

14. Experiments were then inaugurated to determine this point, and advantage was taken of a comparative test then in progress to determine the effect upon the accuracy life of the barrel by reducing the muzzle velocity from 2,300 to 2,200 feet per second. In order to render the results conclusive, the bullets were tested for eccentricity and those only used which, when held at the cylindrical bearing in a lathe, gave an eccentricity of the point of less than 0.001 inch. The base of the bullets entered the chuck three-eighths of an inch and the eccentricity was measured at approximately three-sixteenths of an inch from the point. At the beginning, firings were made into both sawdust and water to determine their relative value as substances into which bullets could be fired without being materially deformed. The advantage, if any, having been found to lie with the sawdust, firing into water was discontinued about the middle of the tests.

15. Table I following contains the record of the firings made and the eccentricity of the point of the bullets recovered. In the last column is the accuracy at 1,000 yards, corresponding to the period in the test noted in the first column.

Table II contains the star-gauge measurements of the rifles used in these firings. Plate 5 shows the erosion in barrels fired 3,500, 4,000, and 5,000 rounds, respectively.

TABLE I.—*Eccentricity of unfired service bullets and of service bullets fired from two United States magazine rifles using ammunition giving 2,300 and 2,200 feet per second muzzle velocity, respectively.*

[Bullets taken from Frankford Arsenal manufacture of February 23, 1906.]

	Substance fired into.	Number of bullets measured.	Eccentricity of point.			Mean absolute deviation. Average of 5 targets of 10 shots each at 1,000 yards. (fixed rest).
			Maximum.	Minimum.	Mean.	
Unfired bullets.....		60	Inch. 0.004	Inch. 0.00025	Inch. 0.0015	Inches.
<i>Firings made with rifle No. 115,572 in which only ammunition giving 2,300 feet per second muzzle velocity was used.</i>						
At beginning	Sawdust.....	17	.003	.0005	.001	8.7
	Water.....	10	.0025	.0005	.001	
After 2,500 rounds	Sawdust.....	10	.0110	.001	.0055	19.1
	Water.....	10	.0150	.0015	.0055	
After 3,500 rounds.....	Sawdust.....	11	.0105	.003	.0059	21.8
After 4,500 rounds.....	do.....	a 9	.0105	.0015	.0062	27.4
<i>Firings made with rifle No. 115,111 in which only ammunition giving 2,200 feet per second muzzle velocity was used.</i>						
After 2,500 rounds	Sawdust.....	12	.0065	.001	.0035	8.2
	Water.....	8	.008	.0015	.0051	
After 3,500 rounds.....	Sawdust.....	a 9	.0075	.002	.0045	11.8
After 4,500 rounds	do.....	10	.0130	.0015	.0067	16.8

a One jacket stripped.

TABLE II.—*Star-gauge measurements of rifles used in the firings, the results of which are tabulated in Table I.*

RIFLE NO. 115372, MODEL OF 1903.

[2,300 feet per second ammunition.]

Distance from muzzle.	Lands.			Grooves.		
	At beginning.	After 2,500 rounds.	After 4,500 rounds.	At beginning.	After 2,500 rounds.	After 4,500 rounds.
Muzzle.....	Inch. 0.3002	Inch. 0.3034	Inch. 0.3003	Inch. 0.3081	Inch. 0.3080	Inch. 0.3082
1 inch.....	.3002	.3004	.3005	.3081	.3086	.3082
2 inches.....	.3002	.3004	.3005	.3080	.3080	.3082
3 inches.....	.3002	.3000	.3005	.3080	.3080	.3082
4 inches.....	.3002	.3000	.3005	.3080	.3080	.3082
5 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
6 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
7 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
8 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
9 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
10 inches.....	.3000	.3000	.3005	.3080	.3080	.3082
11 inches.....	.3000	.3003	.3005	.3080	.3080	.3082
12 inches.....	.3000	.3035	.3005	.3080	.3082	.3084
13 inches.....	.3000	.3007	.3005	.3080	.3082	.3081
14 inches.....	.3000	.3008	.3007	.3080	.3082	.3084
15 inches.....	.3000	.3008	.3010	.3080	.3082	.3082
16 inches.....	.3000	.3010	.3015	.3080	.3082	.3082
17 inches.....	.3000	.3010	.3020	.3080	.3082	.3082
18 inches.....	.3000	.3017	.3030	.3080	.3082	.3082
19 inches.....	.3000	.3030	.3070	.3080	.3082	.3085
20 inches.....	.3000	.3080	.3087	.3082	.3082	.3100
21 inches.....	.3002	(a)	(a)	.3082	(a)	(a)

a Beyond limit of star gauge, 0.315 inch.

TABLE II.—*Star-gauge measurements of rifles used in the firings, the results of which are tabulated in Table I—Continued.*

RIFLE NO. 116111, MODEL OF 1903.

[2,200 feet per second ammunition.]

Distance from muzzle.	Lands.			Grooves.		
	At beginning.	After 2,500 rounds.	After 4,500 rounds.	At beginning.	After 2,500 rounds.	After 4,500 rounds.
Muzzle.....	Inch. 0.3002	Inch. 0.3004	Inch. 0.3008	Inch. 0.3061	Inch. 0.3080	Inch. 0.3082
1 inch.....	.3002	.3004	.3005	.3061	.3080	.3082
2 inches.....	.3002	.3004	.3005	.3060	.3080	.3082
3 inches.....	.3002	.3000	.3005	.3060	.3080	.3082
4 inches.....	.3002	.3000	.3005	.3060	.3080	.3082
5 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
6 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
7 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
8 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
9 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
10 inches.....	.3000	.3000	.3005	.3060	.3080	.3082
11 inches.....	.3000	.3003	.3006	.3060	.3080	.3082
12 inches.....	.3000	.3005	.3006	.3060	.3082	.3084
13 inches.....	.3000	.3007	.3006	.3060	.3082	.3084
14 inches.....	.3000	.3008	.3007	.3060	.3082	.3084
15 inches.....	.3000	.3008	.3010	.3060	.3082	.3082
16 inches.....	.3000	.3010	.3015	.3060	.3082	.3082
17 inches.....	.3000	.3010	.3020	.3060	.3082	.3082
18 inches.....	.3000	.3017	.3030	.3060	.3082	.3082
19 inches.....	.3000	.3030	.3070	.3060	.3082	.3086
20 inches.....	.3000	.3080	.3087	.3082	.3082	.3100
21 inches.....	.3002	(a)	(a)	.3082	(a)	(a)

a Beyond limit of star gauge, 0.315 inch.

16. The results, tabulated in Tables I and II preceding, show that when the barrel is new the eccentricity of the point of the bullets, as they leave the muzzle, is only a fractional part of a thousandth of an inch greater than the eccentricity of the same bullets before firing, and that as the firing is continued both the erosion and the warping of the longitudinal axis increases.

17. This eccentricity, however, large as it is, does not indicate the full deformation sustained by the bullets (see pls. 3 and 4). As the erosion increases, not only the point of the bullet becomes eccentric, but the surface of the rear half of the bullet is deeply scored by the powder gases, the bullets from the point back a half an inch or more are variously deformed, there is a considerable difference between the length of the rifling marks on the same bullet, and the jacket metal is stretched very unequally, as shown by the oblique base of the bullet. It will be noted further that many of the bullets at about three-eighths of an inch from the point have a curious depression.

The bullets are so variously distorted at this point that explanations of the deformation of one is contradicted by the character of the deformation of another. It is evident, however, that there is an oblique and side impact of the bullet as it takes the rifling. In moving forward through the badly eroded part of the bore the bullet acquires considerable velocity and, no longer centered, strikes the rifling obliquely and with greater stress on one side. As the jacket metal is softened by the great heat, the result is a warping of the longitudinal axis of the bullet and unequal stretching of the jacket metal, as shown by the oblique base of the bullets recovered. (Pl. 4.)

18. In this connection it may be of interest to state that in the firings made to determine to what extent the accuracy life of the model of

1903 rifle would be prolonged were the muzzle velocity reduced from 2,300 to 2,200 feet per second the first appreciable falling off in accuracy, which occurred with the 2,300 feet per second ammunition at 2,000 rounds, was not encountered with the 2,200 feet per second ammunition until 4,000 rounds had been fired, and that the accuracy with the latter ammunition after 7,000 rounds was better than with the former ammunition after 4,000 rounds. This difference in accuracy was due to the lower maximum pressure and temperature of the 2,200 feet per second ammunition, which results in less erosion, less heating of the jacket metal, and less violent projecting of the bullet through the eroded section into the rifling.

CONCLUSION.

19. It is believed that these experiments have demonstrated that the comparatively short accuracy life of the model of 1903 rifle is due, almost entirely, to the distortion received by the bullet in the excessively eroded part of the barrel in front of the mouth of the cartridge case, which erosion is relatively insignificant elsewhere. Though the bullet after leaving the badly eroded section passes through two-thirds of the bore, the lands and grooves of which have remained practically unchanged, and leaves the muzzle with a rotational velocity only slightly less than when the barrel was new, it is eccentric, irregular in shape, the metal jacket and lead core are no longer disposed symmetrically about the axis of rotation, and irregularity in flight and loss of accuracy result.

20. These experiments were planned and the results discussed with Capt. W. S. Peirce, Ordnance Department, to whom the writer desires to express his appreciation for the valuable advice given.

Respectfully submitted.

JAY E. HOFFER,

Captain, Ordnance Department, U. S. Army.

SPRINGFIELD ARMORY, MASS., *September 26, 1905.*

26791 O—481-27.

PLATE I

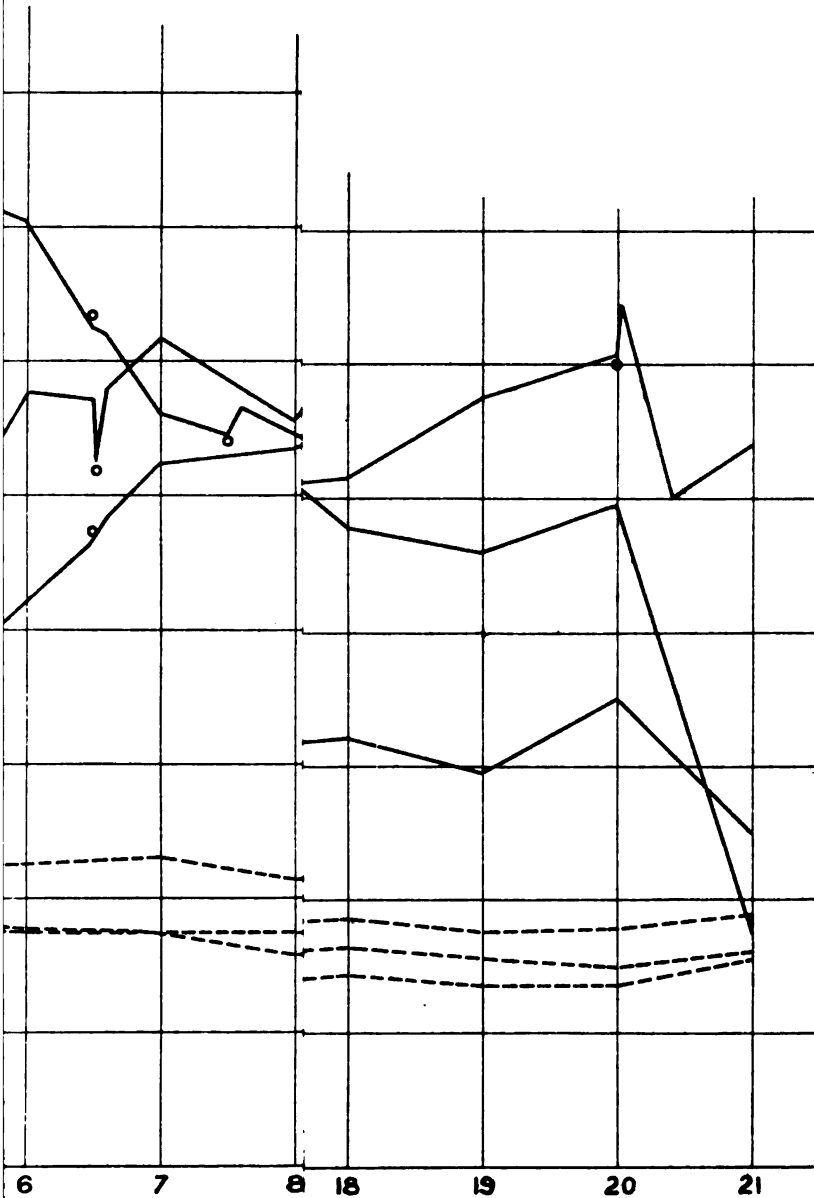
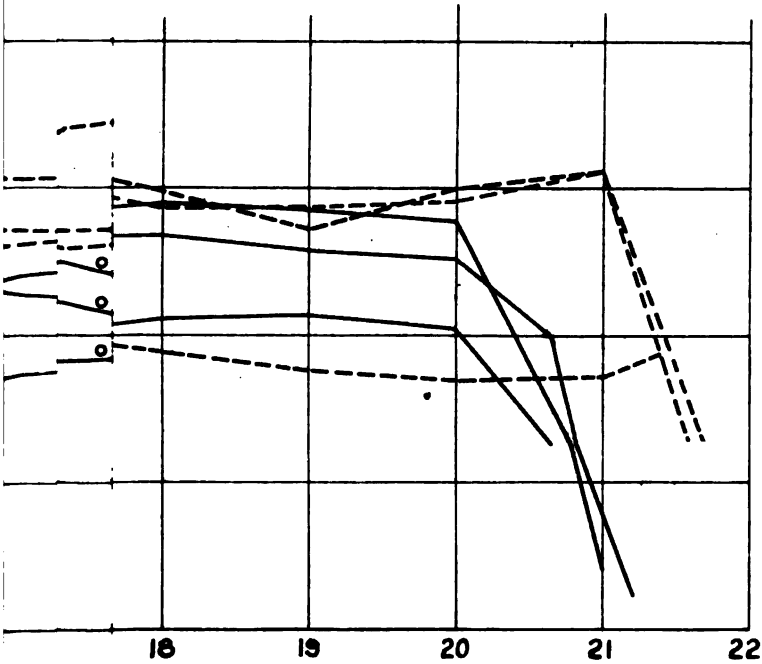


PLATE 2



APPENDIX III, 1905.

FORCED OR FIRED
BARRELS OF
S, MODEL OF 1903.

4 NEW BARREL.



EL FIRED 3500 TIMES.



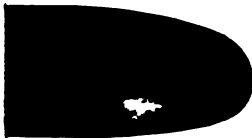
EL FIRED 3500 TIMES.



REL INTO SAWDUST.



M BARREL PREVIOUSLY
TIMES.

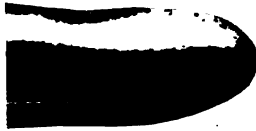


FORCED OR FIRED
BARRELS OF
ES, MODEL OF 1903.

OM BARREL PREVIOUSLY
TIMES.



OM BARREL PREVIOUSLY
TIMES.



E RIFLES, MODEL OF 1903.

N, 2300 FEET PER SECOND, M. V.



130

APPENDIX IV.

CORRESPONDENCE AND REPORTS RELATING TO NEW DESIGN OF EXPERIMENTAL SABERS FOR OFFICERS AND ENLISTED MEN.

MEMORANDUM FOR THE SECRETARY OF WAR.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, June 24, 1905.

In the President's note to the Secretary of War, dated January 4, 1905, he referred to the undamaging character of the sword with which officers and enlisted men are now armed, and remarked that if they carry a sword "they ought to carry a sword that they can cut or thrust with."

The board of army and navy officers, of which Brigadier-General Mills was president, recommended that sword exercise be taught at West Point and Annapolis, which was approved by the Chief of Staff, the Secretary of War, and the President.

Since the date of that report a committee of the General Staff has reported on the bayonet. This committee discarded the rod bayonet recently adopted and readopted the knife bayonet, increasing its length by 4 inches. The General Staff in full committee concurred in the report of the special committee, and the Chief of Staff and Secretary of War approved. The knife bayonet as recommended is now being manufactured for issue with the new service rifle.

Herewith is a report of the special committee of the General Staff upon the saber; also report of the General Staff in full committee upon the same subject, in which they recommend that "sufficient swords of the type recommended by the committee be manufactured and issued to the troops for trial under all conditions, the swords for the use of infantry officers and dismounted men to be of three lengths, viz, 27, 30, and 32 inches; for cavalry officers to be of two lengths, viz, 30 and 32 inches, and for the cavalry enlisted men 32 inches, and that reports on swords issued be required to be rendered within one year after date of their issue for trial."

This report of the General Staff is not satisfactory to the Chief of Staff in that it does not arrive at a definite conclusion. Any test for a period of one year and the reports rendered thereon, unless a war should intervene, would give no more information on the subject than we have now. As this would be the situation, as it seems to me, and

as also I think the recommendation of the committee places us in a decidedly better condition than we are at present, it is the opinion of the Chief of Staff that its report should be adopted and swords manufactured as recommended and issued to the Army at as early a date as practicable—with one exception, viz, I concur with the recommendation of the General Staff in full committee that three lengths of the sword be furnished for foot officers and men and two lengths for mounted officers, and that the sword for mounted men be 32 inches long.

The personal objection of the Chief of Staff to the sword recommended by the committee is its lightness—insufficient weight of metal. If it were a pound heavier, I think it would be a better weapon; but as regards the weight the Chief of Staff will not seriously press his personal opinion in opposition to the opinion of the committee which had before it the masters of the sword at West Point and Annapolis.

If the Secretary of War approves the recommendation of the committee and these remarks, the Chief of Ordnance will cause the swords to be manufactured for issue in accordance with the statements herein contained.

The sword is to have a wooden scabbard covered with leather; the wooden scabbard will enable us to keep a sharp edge on the sword, rendering it an effective cut and thrust instrument.

Respectfully,

CHAFFEE,
Lieutenant-General, Chief of Staff.

The sword seems very light to me, but I concur tentatively.

WM. H. TAFT,
Secretary of War.

26791 O—757-2.

**PART II OF REPORT OF A SPECIAL COMMITTEE OF THE GENERAL STAFF
APPOINTED BY THE FOLLOWING MEMORANDUM:**

Memorandum.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, January 25, 1905.

A letter from the President, dated January 4, 1905, together with papers from the Chief of Ordnance relating to the subject mentioned by the President, viz, the length of the new Springfield rifle, the bayonet, and the sword, are herewith referred, for investigation and report, to the following committee of the General Staff: Lieut. Col. Walter S. Schuyler, Capt. Joseph T. Dickman, Capt. Frank DeW. Ramsey, Capt. Frank McIntyre, and Capt. Peyton C. March.

By order of the Chief of Staff.

BENJ. ALVORD,
Captain, General Staff, Secretary.

The first part of the report of this committee, relating to the length of the new Springfield rifle and the bayonet, having been submitted to the Chief of Staff, the committee proceeded to a consideration of the subject of the sword.

The letter of the President (Exhibit A) states:

If they (our officers) carry any sword, they ought to carry a sword that they can cut or thrust with. Personally I do not see any point in having the cavalry armed with a bayonet, even though the modern cavalryman is nine times out of ten on foot. He might have a sword in his belt, only it ought to be a sword that can do damage.

The Chief of Staff, in his memorandum of January 23, 1905 (Exhibit B), states the following:

A complete and careful report will be made upon the suggestion of the President of the United States, taking into consideration also the report of the Chief of Ordnance, herewith, the ideas involved being:

(c) Is the present saber suitable in every respect, including style and weight, for the service?

Attention is invited to the last paragraph of the report of the Chief of Ordnance, stating that he is preparing a different style of scabbard, with a view to preserving the edge of the sword.

CHAFFEE,
Lieutenant-General, Chief of Staff.

The portion of the report of the Chief of Ordnance bearing upon this subject is as follows (Exhibit C):

29. The letter of the President inclosed with your note refers also to the sword carried by officers. This sword was prescribed by General Orders, No. 81, of July 17, 1902. A cut and description are inclosed herewith.^a It was adopted by the board of officers appointed by paragraph 14 of Special Orders, No. 52, of 1902, which consisted of Brig. Gen. Robert P. Hughes, U. S. Army, Col. Theodore A. Bingham, Corps of Engineers, Lieut. Col. Thomas H. Barry, assistant adjutant-general, U. S. Army, Lieut. Col. Wm. S. Patten, deputy quartermaster-general, U. S. Army, Lieut. Col. Marion P. Maus, Second Infantry, Lieut. Col. Charles G. Treat, Artillery Corps, Lieut. Col. John Van R. Hoff, Medical Department, Maj. George P. Scriven, Signal Corps, Capt. Joseph T. Dickman, Eighth Cavalry, Capt. Hugh J. Gallagher, Sub-stance Department, Capt. Lawson M. Fuller, Ordnance Department.

The sword is intended for both cutting and thrusting purposes, having a sharp point and very slight curvature. It is rather light for a good cutting weapon, and for a perfect thrusting weapon it should be straight. It is, in some respects, possibly, a compromise between lightness and efficiency, and in the last respect is a considerable improvement on the one which it replaced. The board which adopted it had also to consider all other articles of equipment and all articles of uniform, and was thus not only burdened with duties of a widely varied character, but was, perhaps, not selected as it might have been if the subject of the sword had been its principal consideration; notably there is not known to have been an expert swordsman among the membership. The sword as made has not a very sharp edge; of course it could be sharpened to any degree, but as it is used with a metal scabbard it is probable that a fine edge would soon be dulled. I am having made a wooden scabbard, and also a metal scabbard fitted with a wooden strip upon which it is sought to make the edge of the blade bear, in an effort to produce something which will be serviceable and at the same time will not turn a sharp cutting edge. These scabbards will shortly be ready for examination by anybody which may be directed to consider the subject.

Very respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

After a preliminary consideration of the entire subject, the committee communicated with Capt. H. J. Koehler, U. S. Army, master of the sword at the Military Academy, and with Civil Engineer A. C. Cunningham, U. S. Navy, who has charge of the fencing teams from the Naval Academy, and who is a practical swordsman of great experience and known reputation, requesting their opinions, as experts, upon the best style and weight of swords for effective fighting, and whether the present sword answers such conditions.

There was also referred to the committee the report of the joint board of officers of the Army and Navy convened by Special Orders, No. 32, War Department, February 8, 1905; which order directed

^a Not printed.

them, among other things, to "consider and report upon the question of swords and swordsmanship in the Army and Navy."

The portion of their report pertinent to this subject is as follows:

II.—SWORDS AND SWORDSMANSHIP IN THE ARMY AND NAVY.

It is obvious from the experiences of recent wars that the question of swordsmanship in the Army and in the Navy must be approached from different standpoints. Sea fights under modern conditions give no examples of the use of the sword, and it can be said that its use is purely ceremonial on board ship, and on shore at formal military functions. The present naval sword answers this purpose as well as may be desired. The Navy, however, may be used in landing parties, and in such cases a fighting sword is necessary for the officers.

It is recommended that the sword which is or may be in future used by the Army be part of the equipment of every ship in the Navy in sufficient numbers for issue to officers when engaged in landing parties only; such swords to be carried as part of the ordnance equipment of each ship.

As regards the Army, it may be said that as far as the evidence at the disposal of the board goes, the sentiment of the Army is largely against the use of any sword at all by officers in the field, the idea being to replace the sword by the revolver. This was the practice in the Philippines by almost universal consent, and without any orders in connection therewith emanating from superior authority.

This widespread opinion against the sword and in favor of the revolver only is founded upon service under abnormal conditions in a country largely underbrush, and against a foe who rarely stood against a determined advance, and with a sword which itself was an inferior weapon.

A careful consideration of the fighting in the Russo-Japanese war, under modern conditions as regards firearms, and under greatly improved conditions as regards artillery fire, has shown conclusively that the sword is not a weapon of the past.

The increased killing power of the magazine rifle and rapid-fire field gun has operated to force both the Japanese and Russian armies, in order to minimize their losses, to make many night attacks. These night attacks are not surprises by small bodies of troops, but movements of divisions and armies in battle formation. The result of this development has been to force the frequent employment of the bayonet by the enlisted man, and of the sword by the officer, and to increase their importance as fighting weapons. The losses due to "cold steel" in this war will probably never be accurately known, but enough has already been reported officially on both sides to show that the sword has been effectively used, particularly in these night attacks. These being facts, it follows as a corollary that the sword adopted for officers of the Army should be a fighting weapon, and not merely a badge of office.

The board does not consider it part of its duties to go into the matter of types of sword best fitted for use in the Army; this question, it is understood, is now under consideration by a committee of the General Staff. It recommends, however, the adoption for officers of the Army, and for enlisted men who are armed with a sword or saber, of an efficient cut-and-thrust sword (saber), such as shall be determined, after thorough tests of different types of weapon, under the advice of expert swordsmen, to be the best suited for fighting.

The board recommends that instruction in swordsmanship at the Military and Naval Academies be continued throughout the four years' course and that this instruction be, as far as possible, under service conditions as regards the weight and balance of the weapons used; i. e., that broadswords be constructed for use in the fencing instruction of the two academies conforming as far as possible to the weight and balance of the sword adopted for use in the Army.

The board recommends that a manual of sword fencing be prepared for the use of the Army, and that the exercises therein set forth and skill in the use of the weapon be made obligatory upon all officers and enlisted men of the Army who are armed with the sword or saber.

In order that the foregoing requirement may be carried into practical effect, the board recommends that suitable broadswords, masks, and other necessary equipment be constructed by the Ordnance Department, and issued to all posts in the Army in such quantities as are necessary for instruction in the use of the sword.

The report of the board was approved by the Chief of Staff, by the Secretary of War, and by the President of the United States, who directed, also, that report be made to him in sixty days of what had been done to carry the recommendations of the board into effect.

The committee also considered the extract from memorandum report No. 26, of third division, General Staff (Exhibit F), and submitted a separate report thereon (Exhibit G), which may be summarized by stating that the committee considered the proposition to discard the sword as part of the field equipment of the infantry officer, to have been decided adversely by the action of the War Department and the President upon the report of the joint army and navy board, quoted in the foregoing; that a leather scabbard for the sword was desirable; and that the proposition to arm a cavalry regiment with three or four revolvers per man, in lieu of the saber, for purposes of test, was not recommended.

On March 30, Civil Engineer A. C. Cunningham, U. S. Navy, appeared before the committee and gave opinion as to the various models of sword and saber before the committee. The replies, in writing, of Captain Koehler and Civil Engineer Cunningham to the request of the committee for opinions as to style and weight of sword (appended hereto, marked Exhibits "E" and "D") were carefully considered in the presence of Civil Engineer Cunningham.

The blade of the officer's saber furnished by the Ordnance Department was pronounced to be a good one, as to curvature and general design, but too long; and the hilt and gripe were considered faulty for fighting purposes. The glittering scabbard was also condemned, and the suggestion offered that possibly the wood pulp used in making modern trunks could be used for making a scabbard which would be lighter, strong, and nonglittering. The recorder of the committee therefore consulted Mr. Tappan, of Washington, D. C., who has Government contracts involving the use of this material. Mr. Tappan stated that it would not be practicable to make the scabbard of wood pulp, at any reasonable figure, because of mechanical difficulties involved.

The following was found to be the number of sabers on hand in the Ordnance Department on March 30:

	Officers.	Cavalry.
United States	449	6, 224
Philippines	320	3, 138
Total	819	9, 362
Under contract	250	20, 000

A preliminary report was then submitted to the Chief of Staff, stating that "the committee, while it is agreed upon the desirability of certain features of the sword and scabbard—as, for example, that the sword be a fighting weapon and kept sharp, and that the scabbard be of leather, or at least not glittering—can not render a report upon the proper weight and length, and style of gripe, basket, etc., without having expert advice and types of different swords and sabers before it, which are now being sought."

The Chief of Staff thereupon, March 30, 1905, relieved Lieut. Col. Schuyler "from further service on special committee to enable him to proceed to headquarters Southwestern Division." (Exhibit H.)

The committee also called for all papers on file in The Military Secretary's Office and in the office of the Chief of Ordnance containing

comments of officers of the Army, whether favorable or otherwise, upon the present saber and scabbard.

An analysis of all papers so obtained gives the following criticisms:

1. Scabbard should be nonglittering.
2. Form of guard of officer's saber faulty.
3. Material of which guard is made too soft.
4. Enlisted man's saber too heavy.
5. Enlisted man's saber should be primarily a cutting weapon.
6. Sabers should be discarded for cavalry.
7. There should be at least two different lengths of saber, to meet height of officers.
8. Saber should be sharpened.
9. Basket hilt should be flattened.

The only paper on file which submits definite recommendations to improve the saber, in view of criticisms submitted, is from Lieut. Col. James Parker, whose memorandum upon this subject is appended hereto, marked "I."

The following letter from Henry V. Allien & Co., of New York City, together with accompanying models of scabbards, was laid before the committee:

MARCH 11, 1905.

* * * * *

The present regulation sword, General Orders, No. 81, July 17, 1902, was not adopted after a sudden inspiration, but was the result of some years of study and experiments. The former regulation sword, which when ordered was for all officers of infantry, artillery, and staff, was adopted in the following manner: About 1871 General Marcy, then Adjutant-General, called at our store and saying that the swords then worn, regulation of 1851, were objectionable on account of their weight, and asked if we had anything that was lighter. We did have a sample sword made in France and then regulation for the French staff. He asked to be allowed to take it to Washington, and in a short time we heard that it had been adopted for officers as above.

Then changes were gradually made until it was only retained for foot officers of infantry and all staff officers.

Some years ago a movement was started among some officers for a change to a sword more like those used in foreign services, but not so heavy as the British pattern, as the one then regulation was too insignificant in appearance and had the objectionable feature of the shoe and bands on the scabbard being of separate pieces, screwed on, which were constantly getting loose and lost, and the wire around the gripe working loose. Then the gold-plated mountings soon became soiled and required replating at a great expense.

These officers appealed to us, and after working over the matter for sometime and making a number of patterns, both with straight and curved blades, and with the information our Mr. Allien gained during his numerous trips to Europe, the present regulation sword was completed and laid before Gen. J. C. Kelton, with a reputation of being one of the best swordsmen in the Army, and the only change we had to make was in the curve of the blade, making it less curved from center to point, the latter to be in line with the gripe, so as to give greater force in thrusting.

When the uniform board met in Washington in June, 1902, the writer was requested to appear before them for advice and consultation in regard to numerous patterns of caps, shoulder knots, etc., we had made for their consideration and was told to bring the five pattern swords we had been working on—three with straight blades and two with curved—and, as we understood it, the Ordnance Department had the same number to submit, and the result was that one of our swords was adopted, the very one approved by General Kelton.

Those we submitted all had steel scabbards, nickel plated, and, contrary to our experience and advice, the scabbard was ordered to be of German silver, which we knew was too soft a metal to use for that purpose and as you know had to be changed to steel.

We have three wooden scabbards covered with russet leather to fit this sword that the writer had made in Europe after the pattern of the British service scabbard, and should you wish to see them will send them to you with pleasure.

Should you take up the design and pattern of the present regulation sword we respectfully request that you will not only examine those made by the Ordnance Department—we have one in our possession, and if you will examine the comparative outline of blades you will find that their blade departs from the thrusting principle of a curved blade, and they are ground too thin, about one-quarter the length from the point, which will weaken it for thrusting. Their scabbards are too flat—not sufficiently convex—which weakens them, and the branches of guard are too light—will bend if sword is dropped.

The committee also made a careful study of such works upon swords and swordsmanship as were available in the library of the second division; General Staff, and the War Department library, adjourning from day to day with the progress of the work.

On April 13, 1905, the following letter was prepared, formulating the ideas of the committee as far as they had progressed:

Capt. T. C. DICKSON,
Ordnance Department, U. S. Army.

SIR: The committee of the General Staff, having under consideration the general subject of the bayonet and saber, request (the Chief of Ordnance having given his approval verbally) that you will have constructed for the inspection of the committee a saber according to the following design:

Blade to be of same curvature and general appearance as the blade on the present officers' saber, but 27 inches in length, and to be sharpened throughout its edge and for 8 inches of the back from the point, which is to be very sharp; the gripe to be of the design submitted herewith, but the swelling in the center to be removed; any roughening to increase security of gripe to be put upon it which may be convenient; gripe to be free of all metal; guard to be a straight knuckle bow, which will clear a large hand, running into a solid cross plate, which will give protection to both sides of the hand against a thrust for a distance of 1 inch from the blade on the sides, and 1½ inches on the back; the turned-up knob on the present guard to be replaced by curving the crosspiece slightly upward, somewhat on the lines of the enlisted man's cavalry saber; guard to be of light steel. The whole guard to be made as light as is consistent with strength.

Very respectfully,

P. C. MARCH,
Captain, General Staff, Recorder.

The Ordnance Department was requested also, verbally, to have a leather scabbard made for the 27-inch sword described in the foregoing, the general type of scabbard to follow the lines of the British pigskin scabbard, a model of which was furnished them.

On April 19, 1905, Capt. Frank McIntyre was relieved from further duty with the General Staff and with the committee.

The model saber was furnished by the Springfield Armory on May 1, 1905, and in forwarding it the commanding officer of that armory pointed out that "this saber is more to illustrate the shape as it is understood to be wanted than to show finished work."

On May 24, samples of scabbards were received from the Ordnance Department, with the following letter:

1. In compliance with your request, I am instructed by the Chief of Ordnance to return herewith the leather covered English service scabbard lent by you to this Department and to inclose three similar scabbards for the special officers' saber having a 27-inch blade, made by this Department at your request.

2. The hickory scabbard covered with hard rawhide and pigskin would cost, if manufactured in quantity, \$3.15.

3. The hickory scabbard covered with hard rawhide and collar leather would cost \$2.90, and is believed to be the most serviceable of the three designs submitted. The scabbard made of pine covered with rawhide and collar leather could be made for \$2.75.

4. It will be noted that the rings have been covered with leather so as to prevent their rattling. It is thought that the tips on the three samples are unnecessarily large.

5. When no longer required by the special committee, it is requested that the three scabbards made by the Department be returned to this Office.

It was found that none of the scabbards would fit the sword (the scabbards being made at Rock Island and the sword at Springfield), and they were returned for necessary alterations.

The samples prepared were carefully examined in consultation with Civil Engineer Cunningham, who appeared before the committee on several occasions, and Captain Koehler, who was ordered in personal consultation with the committee May 29 and 30 by the War Department. After mature consideration, and with the above expert advice, the committee recommends the following:

1. That the saber adopted for the Army shall be both a thrusting and a cutting weapon.
2. That the same saber is not suited for use by both mounted and dismounted officers, as is the present custom.
3. That there should be two types of saber for the men—one for mounted and one for dismounted men.
4. That the length of blade for dismounted officers and men should be 27 inches and both be of the same general type; the length of blade for mounted officers and men 32 inches; the blade for officers to be of the same type as that recommended for infantry; the blade for the men to be of the same type as that now used in the service, the point being thrown slightly more toward the axis of the blade.
5. That the center of gravity of the dismounted saber should be, as in the model herewith, $3\frac{1}{4}$ inches, more or less, from the base of the hilt; in the mounted saber 5 inches, more or less, from the base of the hilt.
6. That the blade should be sharpened throughout its edge, and for 8 inches from the point along its back, and should always be kept sharp.
7. That the gripe of all sabers, mounted and dismounted, be of the type of the model herewith for both officers and men; the rough wire to be inclosed on both sides by a smooth wire in the manner shown on the small model herewith.
8. That the guard be of the type of the model; with the guard, when projected on a plane perpendicular to the axis of the blade, projecting $1\frac{1}{4}$ inches from the right side of the blade (toward back of hand) instead of 1 inch as in the model; none of the branches of the basket to project outside of the guard; other dimensions of guard as in the model. The nut on the tang of the blade should be counter-sunk, or covered, as in the old style saber; the metal portions around the pommel to be roughened so as to give a firm grasp for the hand; and the steel of which the guard is made, to be chased or dull-finished so as not to reflect light.
9. The saber knot to be retained.
10. The officers' scabbard to be made of wood, covered with dark pigskin; the men's scabbard to be of wood, covered with collar leather, as in sample; the wooden slats composing the scabbard to be treated with oil, under pressure, before being covered with the pigskin or leather; tip on the model to be reduced in size.
11. The steel of which the blade is made should be of such a quality as to take an edge.
12. Each saber issued to the Army to be numbered in the same way that the rifle is.

In arriving at the foregoing conclusions the committee was governed by the following considerations:

The sword for a foot officer is not for individual combat with another swordsman. The occasions when he will use a sword will be limited in number, in a *mêlée* or in night attacks. His opponent will almost invariably be a man armed with a bayonet and not an officer armed with a sword. No sword can compete with the gun and bayonet as to length. The chief requisites for a practical sword for this class of work is that it should be "quick," not heavy on the point. It should be primarily suited for "in" fighting. Approaching the subject from this standpoint the committee recommended the 27-inch model. This sword is believed to be exceptionally well suited for an infantry officer. Its shortness makes it easy to carry through rough country on foot; it is light and perfectly balanced for quick work.

The committee recommended only one length for the dismounted officer for the following reasons:

The joint army and navy board recommended that the broadsword made for instruction at West Point and at the posts have the weight, balance, etc., of the sword adopted for use in the Army. As officers graduate at West Point they will in future have had four years' training with a saber of definite weight and balance. If, after graduation, they were allowed to choose between, say three lengths of saber with different weights, etc., as at present, the practical effect of their long training would be lost, unless, as would seem likely, they all choose the one they had been trained to use. It was, therefore, thought better to limit the length to one type for dismounted officers and one type for mounted.

The man who uses a sword on horseback only must have a longer sword than the footman. The committee while recommending the retention of the general shape of the blade of the present men's cavalry saber has reduced its length to 32 inches from 34.8, and put on it a fighting gripe and guard in place of the present one, which is unanimously condemned.

It is to be pointed out that sharpening the back of all blades for a short distance from the point throws the point slightly nearer the center line of the blade and increases both its cutting and thrusting properties, the ability to make quick, sharp cuts with the back of the blade without reversing the weapon after a parry being considered a great advantage.

The gripe recommended is due principally to Civil Engineer Cunningham. It is constructed so that it tightens in the hand as the saber goes forward in the cut, all sides of the gripe increasing in dimensions toward the pommel. It is more than an inch longer than the present gripe, which increases the actual length of the model recommended by that amount in the thrust, the pommel being in the ball of the hand. It can be used with both hands at a pinch in a *mêlée*.

The deliveries on the contract given by the Ordnance Department for 250 officers' sabers and 20,000 cavalry sabers have been suspended, pending the report of the General Staff upon this subject. In this connection it is to be pointed out that the date of the adoption of the present enlisted man's saber goes so far back as not to be located definitely, but is supposed to be about 1847.

The committee recommends also that the provisions of paragraph 1551, Army Regulations, 1904, be extended to include sabers. This paragraph provides:

1551. Officers serving with troops may draw for their personal use, from stores belonging to the command with which they are serving, one regulation rifle or carbine and one revolver, with the appropriate equipments and the usual quantity of ammunition for each arm. This ordnance property may be used in action or target practice and will be accounted for on returns to the Chief of Ordnance.

The officers' sabers herein recommended are intended to be fighting weapons and not mere badges of authority, and officers should be allowed to draw them on memorandum receipt, as they are now authorized to draw revolvers, etc.

This principle was recognized in the approved report of the joint army and navy board, which makes the fighting sword a part of the ordnance equipment of a ship, to be issued to navy officers.

Exhibit K, herewith, contains a summary of data concerning the swords of the different armies of the world as far as such data is available.

J. T. DICKMAN,
Captain, General Staff.
FRANK DEW. RAMSEY,
Captain, General Staff.
P. C. MARCH,
Captain, General Staff.

JUNE 6, 1905.

MINORITY REPORT.

The only point on which the action of the committee is not unanimous is the length of the blade for foot officers. The recent fate of the bayonet disposes the undersigned to caution in recommending radical changes in the armament of infantry.

There are several ways of looking at this question of length of blade:

1. *Fighting utility.*—This is the most important consideration. The bayonet has the advantage of length of reach. Against a bayonet charge made by a group of men a short "quick" sword is just as good as a longer one, perhaps better. When there is any chance for individual combat the following advantages accrue to the sword: Greater freedom of movement, greater quickness, greater endurance, play against the left hand, wrist, and forearm of the adversary, with a sharp cutting edge. In shortening the blade of the sword we soon arrive at a stage where the swordsman can no longer attack this weak point of his antagonist without coming in reach of the short, quick thrust of the bayonet, and which renders it unnecessary for the latter to resort to the lunge, which is more uncertain, more easily deflected, and more dangerous if parried. For this reason it is believed to be unsafe to go much below 30 inches in length of blade.

2. *Suitability.*—While a 27-inch blade might be well suited to an officer 5 feet in height, a 30 or 32 inch blade would probably be wielded with equal ease by a 200 pound man, 6 feet tall. The advantage of increased power and length of reach available would thus be better utilized.

3. *Appearance.*—This question, though of minor importance, should not be disregarded, other things being equal. A 27-inch weapon, worn by a large, powerful man, would invite unfavorable comment. In the past our officers have had choice as to length of weapon—most recently, 30, 32, 34 inches. The French infantry sword varies in length—900, 850, 800, and 750 mm., or, approximately, 36, 34, 32, 30 inches.

4. *General usefulness.*—A large proportion of our infantry officers are mounted at times. A sword of medium length would serve both purposes, mounted and dismounted, combat and ceremony.

This committee recently recommended the lengthening of the bayonet by 6 inches; the shortening of the sword by from 3 to 7 inches seems to present a contradiction.

For these reasons the undersigned recommends that the sword for infantry officers be 28, 30, or 32 inches in length. The master of the sword at West Point concurs in the view that officers be allowed some choice as to length of blade.

J. T. DICKMAN,
Captain, General Staff.

EXHIBIT A.

WHITE HOUSE,
Washington, January 4, 1905.

THE SECRETARY OF WAR:

I must say that I think that ramrod bayonet about as poor an invention as I ever saw. As you observed, it broke short off as soon as hit with even moderate violence. It would have no moral effect and mighty little physical effect. I think the suggestion of a short triangular bayonet a great improvement. After you have gone over this subject of the bayonet and the sword, do take it up with me.

I wish our officers could carry rifles. If they carry any sword they ought to carry a sword that they can cut or thrust with. Personally I do not see any point in having the cavalry armed with a bayonet, even though the modern cavalryman is nine times out of ten on foot. He might have a sword in his belt, only it ought to be a sword that can do damage.

I am particularly anxious that we should have a thorough test made of the long and the short rifle (that is, of the 24-inch and 30-inch rifle) at some place like that in Utah, where several companies of men can be employed at firing both weapons at long ranges. This ramrod-bayonet business does not make me feel that we can afford to trust too much to theory of the closet variety. I would like to have the opinion of Captain March, and then the opinion of the other military attachés who saw the fighting between the Russians and Japanese, about both the bayonet and the sword. I would also like to have the opinion of any of our officers in the Philippines who have seen the bayonet actually used.

THEODORE ROOSEVELT.

EXHIBIT B.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
January 23, 1905.

General GILLESPIE:

Please have this read at the next meeting of the General Staff with a view to suggesting a committee of five officers to take this matter under consideration and submit report.

The Chief of Ordnance has in preparation, and will present for the inspection and consideration of the General Staff several different styles of bayonet adapted to the new Springfield rifle. Upon examination of these a complete and careful report will

be made, upon the suggestion of the President of the United States, taking into consideration also the report of the Chief of Ordnance herewith; the ideas involved being:

- (a) Shall we adhere to the 24-inch barrel or have it lengthened to 30 inches?
- (b) Shall we change the style of the bayonet, and if so, what kind should be adopted, and shall it be used in any other way than as a bayonet?
- (c) Is the present saber suitable in every respect, including style and weight, for the service?

Attention is invited to the last paragraph of the report of the Chief of Ordnance, stating that he is preparing a different style of scabbard with a view to preserving the edge of the sword.

CHAFFEE,
Lieutenant-General, Chief of Staff.

EXHIBIT C.

Exhibit C is printed as Exhibit A to Appendix I.

EXHIBIT D.

ANNAPOLIS, MD., *March 29, 1905.*

DEAR CAPTAIN: In response to your recent letter, I take pleasure in submitting some brief notes concerning the sword, its accessories, and use, which I trust may be of interest to you.

After careful consideration it seems to me that the average length of a sword blade for a footman should be about 27 inches, and for a horseman about 30 inches; a variation of about 1½ inches might be allowed each way to suit individual cases. These lengths seem rather shorter than we are accustomed to, especially for the horseman. In the case of the footman portability must have consideration and also the passing over obstructions with the sword sheathed, and about 27 inches seem to me to be the length that meets the most of the conditions. In the case of the horseman I have had in mind a sword that would still be valuable to him when dismounted and not an incumbrance.

A footman's sword, I think, should be carried in a frog; this insures a known position of the hilt ready for grasping and permits walking or running with the least interference; moreover, in passing through brush, climbing, or other unusual proceedings, the frog can be slipped forward or back as best suits the conditions encountered; if the frog slips on the belt with a back spring it could also be readily attached to a suitable band sewed on to an overcoat. It does not seem right to me that a horseman should carry his sword attached to his saddle, in action, at least, though it might be well done on the march. If dismounted he loses a weapon and perhaps furnishes one to a foe. A horseman's sword could be carried in a suitable length frog and still not quite drag when he is dismounted; the height of the attachment could easily be varied with a buckle.

The gripe on a sword is very important; the cross section should be such that the sword can not turn in the hand and the profile such that an extension can be made with the least distortion of the wrist. This seems best accomplished by having the pommel so shaped that it will rest in the base of the hand under the large thumb muscle and necessitates a change in the ordinary manner of attaching the knuckle guard. A beak on the pommel gives a fine hold for the last three fingers. The gripe should be free from all metal which makes it slippery, and in cold weather, uncomfortable.

The guard of a working sword must be a compromise between perfect protection for the hand and adaptability for carrying under service conditions. A knuckle bow and as much of a cross plate as can be allowed seems the best. In the cross plates some protection to both sides of the hand and the thumb should be provided. In ordinary guards the back of the hand receives the most protection and consequently confines the user largely to one position. Any sword knot that is used should be light and simple and attached near the pommel.

The scabbard of a sword should be as light as possible and of a material that will not dull a sharpened edge or point; it should be of a material that will not clatter and all mountings should be free from projections that will catch in anything passed over or through. A scabbard should never drag on the ground. It is possible that properly treated raw hide will fill more desirable conditions than anything else. It is very strong, light, tough, and hard to cut.

The most attractive sword blade I have seen is in a sword captured from a Spanish infantry officer in Cuba. The blade has a full curve which gives a fine balance and allows the sword to hang straight from one sling. The outer half of the blade has a diamond section and the inner half a rectangular section except for the front edge. It is about three-fourths inch wide and had no grooves.

Both a footman's and horseman's sword should be as light as will stand the general conditions of service, and with a suitable steel this can be much lighter than at present. The weight carried is very important. Lightness also aids in parrying. With a light sword the smashing blow is lost, but is made up for to some extent if a sharp edge is maintained. Besides, an attack with the point is the best for both a footman and horseman; it reaches farther than a blow, is harder to parry, is more deadly, and is best delivered with a lightsword. A thrust is as easily delivered with a curved sword as with a straight one. Note that an accomplished fencer has a curve in his foil blade.

The point of a sword should be very sharp; the entire front edge and from 6 to 12 inches of the back edge should be sharp. On a lightly clad man effective blows may be delivered with the edges, and there are dangerous cuts made with the back edge on the neck and arms. On a heavily clad man edge blows will not be dangerous, but thrusts can not be stopped by heavy clothing.

The steel from which sword blades are made is very important. That generally used at present is too soft to take or hold a good cutting edge, and under severe strain will be permanently bent.

The sword blades which have achieved merit in history have been made from steel produced by processes similar to the "cementation process," in which very pure wrought iron has been converted into steel by being packed in charcoal and heated until the necessary amount of carbon has been absorbed. Steel made in this way retains all of the welding properties of the original wrought iron. The raw steel is at first ununiform, but by repeatedly hammering out, cutting up and rewelding, a well worked and uniform product is finally secured. In Damascus blades, layers of wrought iron are introduced to secure more perfect welding and are shown in the different colored lines, the twisting of which indicate the piling and folding over of the material as it is successively worked. "Blister steel" made from wrought iron is still produced, but instead of being reworked into single, double, or triple shear steel, is broken up for melting into crucible steel.

The steels generally used now for all purposes are melted during the process of manufacture. In the melting all of the cinder passes off and there is no flux left for welding.

It might be possible to still secure blades made from blister steel; if not they should be made from a high quality of crucible steel containing enough carbon so that the blade can not be permanently bent in use.

The use of the sword in the field for a footman has never been developed in this country. Fencing-room tactics are entirely inapplicable, the conditions being so very different. All parts of the person are open to attack, and there are no rules or limitations in a combat. It is entirely feasible to teach a man to defend himself with four simple parries in a very short time, and if the attacks are not well made to make effective returns from these parries. With an emptied revolver in the left hand to use in parrying, and even thrusting or striking at close quarters, a swordsman becomes still more formidable.

Swordmanship can be made an attractive and inexpensive pastime, and is an excellent physical exercise, requiring mental activity as well. The principles of fencing can be applied to a club or swagger stick, and the man who understands it is in a better position for offense or defense, with whatever implement he may have in his hands, than the one who does not.

Very respectfully,

A. C. CUNNINGHAM,
Civil Engineer, U. S. Navy.

Capt. P. C. MARCH,
General Staff, U. S. Army.

EXHIBIT E.

UNITED STATES MILITARY ACADEMY,
West Point, N. Y., March 28, 1906.

SIR: Your communication of March 22 was received just as I was about to depart for New York in charge of our fencing team, which engaged in the intercollegiate fencing competition on March 24 and 25.

The answer to the question, shall a sword be carried at all (by unmounted officers I suppose this means), is usually dependent upon the degree of familiarity with its use. If a man has become more or less proficient in the use of the sword the chances are that he will readily answer in the affirmative. If on the other hand this familiarity is lacking it is likely he will just as readily answer it in the negative.

Having had no experience in the field I am not in a position to speak authoritatively on this question. However, so far as I am personally concerned, I should certainly put up with any inconvenience a sword—that is, the carrying of a sword—may occasion in order to have it at my disposal, as I should feel that I still possessed a weapon with which I could defend myself against anything except bullets. The sword now worn by officers is, in my opinion, unserviceable. I have endeavored to find a sword in our museum here that would fit our requirements, but could find none. I did find a blade, however, which I like very much and which I am going to send you. I believe a sword should be useful both as a cutting and thrusting weapon. Its blade should, therefore, be slightly curved. The curve of our officers' saber is just about right, as its curve gives just sufficient swing in a cutting stroke and is not too great to interfere with its usefulness as a thrusting weapon. The sword I am sending is straight, but its blade is such a strong one and constructed along the lines best suited for service that I believe if a blade were manufactured embodying all the good qualities of this blade and given the curve of ours we would have an ideal sword. The weight is just about right, too, about 1.8 pounds. I do not approve of the hilt. This should be changed to a basket hilt with three light steel branches; these branches to be joined and flattened out at the pommel end, so that there is a flat surface about six-tenths of an inch presented to the inside of the hilt. You will find this in the saber I am sending. The gripe should be about five inches long, as a footman will use the sword with his thumb extended along the back of it. The back of the gripe should be flat about six-tenths of an inch and roughened to give the thumb a grip. The diameter of the gripe should be greatest in the middle and taper slightly to front and rear.

The blade should not exceed 32 inches. I believe such a sword, with the center or balancing point not more than a scant 5 inches from the guard, will make a useful, effective, and handy weapon. The edge should be sharpened from a point 8 inches from the guard and the back 12 inches from the point.

I do not know whether your board is going to take up the question of changing the cavalry saber. I believe a whole lot has been said in condemnation of that saber that can not be substantiated. Many have complained because of its weight, and yet it weighs only 2.2 pounds. It also has been called a club, but that, in my opinion, is just what a saber should be—a club with a keen edge. If it were not built along the lines of a club it would lack driving power. In speaking about the "feel" and handiness of the saber we often make the mistake of judging it from the standpoint of a foot soldier's weapon, a weapon which is dependent upon the strength and suppleness of the wrist, while the cavalry saber is primarily a weapon which the arm and not the wrist is intended to wield. That being the case, much that is now taught in the saber manual for mounted troops is not only wrong but useless, as it gives men false impressions, which leads them to find fault with a really good weapon. I believe we have a good saber, so far as weight, construction, and usefulness is concerned, and the only change I should recommend is the hilt. That is clumsy and no doubt is the cause of much of what has been said in objection to the saber.

Very respectfully,

H. J. KOEHLER,
Captain, U. S. Army.

Capt. P. C. MARCH,
General Staff, U. S. Army.

EXHIBIT F.

[EXTRACT FROM MEMORANDUM REPORT (No. 26) OF THIRD DIVISION GENERAL STAFF.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, February 25, 1906.

* * * * *

"The question of the saber, scabbard, and revolver.

"(a) The desirability of discarding the sword as a part of the field equipment of the infantry officer.

"(b) The substitution of a suitable leather or dull-covered metal scabbard for the shining scabbard now in use.

"(c) The arming of each trooper in a selected regiment of cavalry with three or four revolvers, and the careful training of the regiment in revolver firing, with a view to making a practical test of the expediency of substituting the revolver for the saber."

(Note by Chief of Staff: "The question (c) as stated is not, it is believed, sufficiently to the point.")

"The board is not advised, as it should be, to assume the saber sharpened, effective as a cutting and pointing instrument, troops properly instructed in its use, conditions possible and expected to prevail, and under such assumptions the board should report whether or not the saber is of such little value as to justify its abandonment as an arm of the cavalry soldier.")

"The division recommends that the first of these questions, namely, the desirability of discarding the sword as a part of the field equipment of the infantry officer, be referred to the infantry board at Fort Leavenworth, Kans., for consideration and report."

"In regard to the second question, the present saberscabbard has been universally condemned by officers at the maneuvers, and the opinion seems unanimous that it should be replaced by a scabbard that would not glitter in the sunlight. On many occasions, at different maneuvers, the location of a body of troops otherwise concealed has been betrayed by the glittering of the sabers; and there seems to be nothing in favor of the present scabbard that can compensate for this evil."

"In regard to the third question, it is recommended that this be referred to the cavalry board at Fort Riley, Kans., for careful consideration and report as to the means of making a practical test of the expediency of substituting the revolver for the saber. As set forth in memorandum report No. 131, the question of 'saber versus revolver' has been discussed ad nauseam, but has never yet gotten beyond the realms of pure academic theory. Moreover, the question is one to which sentiment rather than plain practical sense has too often been applied. The question is an important one, and it seems to deserve practical consideration. It is desirable that this question be taken up seriously by a board of cavalry officers, as it is believed that they are the only ones to make a satisfactory decision upon the proper weapon for their arm of the service. The question should be considered by experienced cavalry officers in a broad-minded, common-sense, practical way, without, if possible, being influenced by prejudice against or predilection for either the saber or the revolver."

* * * * *

Official copy respectfully furnished the special committee of the General Staff appointed by memorandum from this office of January 25, 1905, and of which Lieut. Col. Walter S. Schuyler is senior member, for report.

By order of the Chief of Staff:

BENJ. ALVORD,
Captain, General Staff, Secretary.

EXHIBIT G.

[MEMORANDUM REPORT.]

WASHINGTON, March 29, 1906.

This is an extract from memorandum report No. 26, of third division General Staff, as follows:

"8. The question of the saber, scabbard, and revolver.

"(a) The desirability of discarding the sword as a part of the field equipment of the infantry officer.

"(b) The substitution of a suitable leather or dull-covered metal scabbard for the shining scabbard now in use.

"(c) The arming of each trooper in a selected regiment of cavalry with three or four revolvers and the careful training of the regiment in revolver firing, with a view to making a practical test of the expediency of substituting the revolver for the saber."

This extract is referred by the Chief of Staff to the special committee of the General Staff, appointed by memorandum of January 25 from the Office of the Chief of Staff (and of which Lieut. Col. W. S. Schuyler is senior member), for report.

"(a) The desirability of discarding the sword as a part of the field equipment of the infantry officer."

The report of the joint army and navy board convened by Special Orders, No. 32, War Department, 1905, having been approved by the Chief of Staff and by the Secretary of War, the question raised in (a), quoted above, has been decided adversely, and need not be further discussed here.

"(b) The substitution of a suitable leather or dull-covered" (presumably dull-colored is meant) "metal scabbard for the shining scabbard now in use."

This point is thought to be well taken. The English, as a result of the Boer war, have a leather-covered scabbard with their sword; the Japanese, as a result of their careful study of all military details, have adopted the same thing. They have a leather case which slips on over the shining scabbard. Some were noted in russet and some in black. Other officers had a khaki strip of cloth wound around their scabbards to prevent the glitter betraying the position of the troops. The proper scabbard for field service will be taken up by the committee in rendering its report under the original memorandum of the Chief of Staff.

"(c) The arming of each trooper in a selected regiment of cavalry with three or four revolvers and the careful training of the regiment in revolver firing, with a view to making a practical test of the expediency of substituting the revolver for the saber."

Upon this recommendation the Chief of Staff notes:

"The question (c) as stated is not, it is believed, sufficiently to the point.

"The board is not advised, as it should be, to assume the saber sharpened, effective as a cutting and pointing instrument, troops properly instructed in its use, conditions possible and expected to prevail; and under such assumptions the board should report whether or not the saber is of such little value as to justify its abandonment as an arm of the cavalry soldier."

In considering this proposition, it must be remembered that the present equipment of a cavalry soldier includes carbine, revolver, and saber. He already has one revolver for use when such a weapon can be used, so the proposition to increase the number to three or four at the expense of the saber, betrays an appreciation of the inherent weakness of the revolver as a weapon for mounted troops, i. e., the impossibility of reloading it during a charge.

The committee does not consider the suggestion contained in (c) a practical one. If a cavalry regiment were armed with three or four revolvers per man, and the men carefully instructed in their use, the effect of this regiment against an infantry firing line, as compared with a cavalry regiment armed with an efficient saber and well instructed in its use, would still be a matter of guesswork and could be really determined only by actual warfare. These revolver cavalymen might be charged through dummies, and hits counted; the cavalymen armed with the saber might do the same thing; and the conclusions reached be utterly valueless.

The training of the American cavalry gives the arm its greatest efficiency when fighting on foot. The carbine can not be replaced by any other weapon or combination of weapons. If the revolver is to replace the saber in the charge, the cavalry officer will have to move to the rear, where he can neither be heard nor lead his men during a charge; or he will be shot in the back.

The committee, therefore, recommends that (c), memorandum report No. 26, third division, be not favorably considered.

For the committee.

W. S. SCHUYLER,
Lieutenant-Colonel, General Staff, Chairman.

EXHIBIT H.

MEMORANDUM.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, March 29, 1905.

The committee, while it is agreed upon the desirability of certain features of the sword and scabbard, as, for example, that the sword be a fighting weapon and kept sharp, and that the scabbard be of leather or at least not glittering, can not render a report upon the proper weight and length, and style of gripe, basket, etc., without having expert advice and types of different swords and sabers before it, which are now being sought.

The views of the committee upon the propositions of the third division of the General Staff upon this subject are now in the hands of the Chief of Staff, but a thorough examination of the entire subject necessary to render a satisfactory report will make it impossible to render a report by April 1.

W. S. SCHUYLER,
Lieutenant-Colonel, General Staff, Chairman.

Colonel Schuyler relieved from further service on special committee to enable him to proceed to headquarters Southwestern Division.

CHAFFER.

MARCH 30, 1905.

EXHIBIT I.

MEMORANDUM ON THE CAVALRY SABER.

Much of the objections in our service to the saber as a cavalry weapon arises from the fact that the saber, as issued, is not sharp.

A sharp saber at close quarters is a formidable weapon. A dull saber is nothing more than a steel club.

It is therefore recommended—

1. That the saber, not being intended for dismounted work, should be carried on the saddle exclusively.

2. That it should have a scabbard not of metal. (a) A metal scabbard turns the edge; (b) it reflects light and discovers the position of the troops to the enemy; (c) it is heavier than a wooden scabbard.

3. The saber not being easy to sharpen at any time, and especially in the field, should be issued already sharpened. To avoid accidents a few of the duller sabers, if necessary, can be issued to recruits.

4. The scabbard should be made of wood and leather, and it should be sufficiently strong not to break under ordinary usage. It is believed the wood in it should be thicker and more rounding, as in the scabbard of the Japanese sword. This would give it more strength. The following is approximately the cross section of the wood and leather scabbard issued me for trial:



The following is the cross section I would recommend:



5. In case the present saber is to be adapted to the wooden scabbard, it is recommended that the basket hilt, which projects and sticks into the side of the horse, be changed into a flat hilt like that of the regular artillery saber; also that the saber blade be reduced in length, measuring from the hilt, 32 inches. This reduction in length would make the scabbard less liable to break, and make the saber handier, easier to carry, and nearly or quite as effective in a charge against cavalry where the saber is used only at the moment of the shock and in the *mêlée*, and where the handiness of the weapon counts for as much as its length.

6. In case a new saber is adopted I favor a weapon nearly straight, with blade 32 inches long; keen cutting edge; heavy broad blade, so as to bring the center of impact nearer the point; light hilt and gripe, having a flat hilt like the old artillery saber. With a saber nearly straight the wooden scabbard will be stronger and easier to manufacture.

Respectfully submitted.

JAMES PARKER,
Lieutenant-Colonel, Assistant Adjutant-General,

EXHIBIT K.

DATA CONCERNING SWORDS OF VARIOUS COUNTRIES.

1. *Great Britain*.—Length, blade $32\frac{1}{2}$ inches, hilt $5\frac{1}{2}$ to $5\frac{3}{4}$ inches, gripe 5 inches; weight, without scabbard, 1 pound 11 ounces to 1 pound 12 ounces.

NOTE.—This country has changed saber and scabbard since Boer war.

2. *Italy*.—Officer's sword: Length in proportion to the height of the officer, which should not be more than 8 centimeters from the ground.

3. *Germany*.—Length varies, with the several classes of weapon, from 980 up to 1,063 millimeters (millimeter equals 0.03937 inch); weight, without scabbard, including blade and gripe, varies from 900 up to 1,065 grams (28.34 grams equals 1 ounce).

(1) Cuirassier sword: Length, including gripe, 1.035 to 1.065 meters; weight, 1,020 grams; distance from base of hilt to center of gravity, 120 millimeters; guard, of tombac for officers, brass for men; gripe, of hard wood wrapped with twine, and covered with leather wound with wire; scabbard, steel, two bands.

(2) Cavalry saber: Length, 992 millimeters; weight, 960 grams; distance from base of hilt to center of gravity, 130 millimeters; guard, of steel, no basket but flat; gripe, hard rubber; scabbard, steel, two bands.

Blades double-edged for one-third of length.

Artillery saber: Length, 980 millimeters; blade more curved, otherwise about the same as cavalry saber.

4. *Belgium*.—Length, Montmorency sword 1.40 meters.

5. *Russia*.—The universal pattern for all regular cavalry is the so-called shashka, a curved sword 3 feet 4 inches long and weighing 2 pounds and 11 ounces. Its scabbard is of wood, covered with leather. Date, 1886.

A somewhat bent sword, 87 centimeters long, with a bent hilt, which is carried in a wooden scabbard with a black covering by means of a belt over the right shoulder, is carried only by the officers and color sergeants. There are three sorts of shashkas—the dragoon, Cossack, and artillery. 1898.

6. *Austria-Hungary*.—Length, from point to hilt, the sword for different branches of the service varies from 654 to 921 millimeters; breadth at hilt varies from 30 to 37 millimeters; thickness of back at hilt varies from 7 to 8.8 millimeters; weight, sword without scabbard from 660 to 1,240 grams, scabbard from 262 to 940 grams.

7. *France*.—Length, 29.53 to 35.43 inches; weight (without scabbard), 25.7 to 26.7 ounces.

8. *United States*.—Officers': 30 to 34 inches; weight, 20.2 to 22½ ounces.

Cavalry and field artillery saber: Length, 34.8 inches; weight, 34.63 ounces.

Noncommissioned officers' sword: Length, 26 inches; weight, 24.07 ounces.

Cadet sword: Length, 28.7 inches; weight, 19.26 ounces.

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APPENDIX V.

CORRESPONDENCE RESULTING IN THE ADOPTION OF THE CALIBER .22, RIM-FIRE, LONG CARTRIDGE FOR GALLERY PRACTICE.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, May 9, 1905.

SIR: 1. With the view to reducing the cost of ammunition for gallery practice without sacrifice in accuracy, this Department has conducted at the Springfield Armory an exhaustive series of experiments with several kinds and calibers of cartridges, some of which require the use of chamber plugs, subcaliber tubes, or barrels specially bored and chambered.

The results of the tests show the choice to lie between the present service gallery practice cartridge and a rim-fire, caliber .22, long, cartridge. The former cartridge is now used in service arms; the latter requires arms provided with barrels specially bored and chambered. Should the caliber .22 cartridge be adopted in place of the present gallery-practice cartridge, it is proposed to issue to each organization the necessary number of caliber .22 barrels with receivers for assemblage, in place of caliber .30 barrels and receivers, in service arms for gallery-practice instructions. This method does not require the manufacturing of special arms, and provides an arm for gallery practice differing from the service one only in the caliber of the bore and a slightly heavier barrel. This same system could be used by the organized militia of the several States and Territories.

2. The mean vertical, horizontal, and absolute deviations of the different targets made with the two kinds of cartridges under consideration, at 25, 50, 75, and 100 feet, are tabulated on inclosure 1, herewith. Each target consists of 10 consecutive shots fired under as nearly identical conditions as possible; the dimensions are inches; all targets were made by the same marksman. Photographs of each target are also inclosed.^a The average mean absolute deviation at each range was as follows:

[Model of 1903 rifle.]

Ammunition.	Mean absolute deviation.			
	25 feet.	50 feet.	75 feet.	100 feet.
Gallery practice	0.15	0.31	0.51	0.52
Caliber .22, rim fire .....	.20	.35	.58	.78

^a Not printed.

It will be noted that no material difference in the accuracy exists at 25, 50, and 75 feet. The range prescribed in Firing Regulations for Small Arms, 1904, for gallery practice is 50 feet. Reports received from the Army show that ammunition reloaded by troops is less accurate than that loaded at Frankford Arsenal; the latter was used in these tests.

3. Caliber .22 rim-fire cartridges, long, can be purchased in small quantities at \$2.85 per 1,000; the powder, bullets and primers for reloading 1,000 gallery-practice cartridges cost \$3.65.

4. The comparative advantages and disadvantages of the use of the two cartridges appear to be:

ADVANTAGES.

Gallery practice:

Caliber .30—

- (a) Requires no change in service arms.
- (b) When loaded with care, slightly more accurate up to and including 75 feet, and much more accurate at longer ranges.

Caliber .22—

- (a) About 22 per cent cheaper.
- (b) No reloading.
- (c) Probably more accurate than gallery practice ammunition loaded by troops.

DISADVANTAGES.

Gallery practice:

Caliber .30—

- (a) More expensive.
- (b) Must be loaded by troops.
- (c) Unless loaded with great care, accuracy not satisfactory.

Caliber .22—

- (a) Requires issue of special barrels with receivers.

5. The adoption of the caliber .22 rim-fire cartridge, long, appears to be worthy of consideration by some such board of officers as that convened for the revision of Firing Regulations for Small Arms for the United States magazine rifle, model of 1903; the infantry board, Fort Leavenworth, Kans.; or the board of officers convened by paragraph 1, Special Orders, No. 91, dated War Department, Washington, April 20, 1905, for recommending a sight for service arms, the members of which were specially selected as being expert with the rifle.

Reference of this letter to one of the above-mentioned boards is therefore recommended, with instructions to subject the two systems to test and to recommend the one found most suitable for adoption. Due consideration should be given in this connection to the needs and facilities of the organized militia of the several States and Territories for gallery practice.

In case this subject should be referred to the last of the above-mentioned boards, it is requested that it be instructed to delay consideration of this subject until after a conclusion has been reached as to the design of sight that is best suited for adoption.

6. The Department has one United States magazine rifle, model of 1903, equipped with a caliber .22 barrel, and upon being informed of the board to which this paper is referred will give instructions to ship it, with ammunition, to that board.

Respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

The MILITARY SECRETARY, U. S. ARMY.

[First indorsement.]

MIL. SEC. OFFICE,
May 11, 1905.

To the Chief of Staff.
16 inclosures.

OFFICE OF THE CHIEF OF STAFF.

Received May 11, 1905.

[Second indorsement.]

WAR DEPARTMENT,
THE MILITARY SECRETARY'S OFFICE,
Washington, May 15, 1905.

Respectfully referred, by direction of the Acting Chief of Staff, through the commandant, Infantry and Cavalry School and Staff College, to the infantry board, Fort Leavenworth, Kans., for consideration and report.

These papers to be returned.

HENRY P. MCCAIN,
Military Secretary.

16 incls.

[Third indorsement.]

INFANTRY AND CAVALRY SCHOOL AND STAFF COLLEGE,
Fort Leavenworth, Kans., May 18, 1905.

Respectfully transmitted to Col. Charles B. Hall, Eighteenth Infantry, president infantry board.

J. F. BELL,
Brigadier-General, U. S. Army, Commandant.

[Fourth indorsement.]

FORT LEAVENWORTH, KANS., *October 1, 1905.*

Respectfully returned to the Military Secretary, War Department, Washington, D. C., inviting attention to the inclosed proceedings of the infantry board, Fort Leavenworth, Kans.

All papers in the case returned.

CHAS. B. HALL,
*Colonel Eighteenth Infantry,
President of Board.*

Received back M. S. O., October 4, 1905.

[Fifth indorsement.]

WAR DEPARTMENT,
THE MILITARY SECRETARY'S OFFICE,
Washington, October 5, 1905.

Respectfully returned, by direction of the Acting Chief of Staff, to the Acting Chief of Ordnance.

W. P. HALL,
Military Secretary.

Additional A accompanying.

[Sixth indorsement.]

OFFICE OF THE CHIEF OF ORDNANCE,
Washington, October 9, 1905.

1. Respectfully returned to The Military Secretary, recommending approval of the adoption, for gallery practice, of the caliber .22, rim fire, long, ball cartridge, in place of the present design of gallery-practice cartridge in view of the unanimous recommendation of the infantry board. The difficulty experienced by the board in loading the experimental arm furnished it can be overcome.

2. It is recommended that there be issued to each company of infantry, troop of cavalry, and battery of seacoast artillery four caliber .22 barrels with receivers and that each company or troop be given an annual allowance of 10,000 rounds of caliber .22 cartridges instead of the same number of the present design of gallery-practice cartridges provided for in Article XXVII of General Orders No. 122 of 1905.

3. If the adoption of the caliber .22 cartridge for gallery practice is approved, it is intended to issue four caliber .22 barrels with receivers to each organization at the time the latter is equipped with the United States magazine rifle, model of 1903. The manufacture of caliber .22 barrels with receivers for the United States magazine rifle, model of 1898, will be undertaken as soon as practicable in order that the organized militia of the several States and Territories may, by procuring these barrels and receivers, secure the advantages resulting from the adoption of the caliber .22 cartridge for gallery practice. Before the issue of the caliber .22 cartridge for gallery practice is commenced recommendations will be submitted as to the changes its adoption will necessitate in General Orders No. 122 of 1905.

A. H. RUSSELL,
Lieutenant-Colonel, Ordnance Department, U. S. Army,
Acting Chief of Ordnance.

[Seventh indorsement.]

WAR DEPARTMENT,
THE MILITARY SECRETARY'S OFFICE,
Washington, October 13, 1905.

Respectfully returned, by direction of the Acting Chief of Staff, to the Acting Chief of Ordnance approved, as recommended in the sixth indorsement hereon. Early return of the paper is requested.

W. P. HALL,
Military Secretary.

EXHIBIT A.

[Model of 1903 rifle.]

	Accuracy (each target 10 shots).					
	25 feet.			50 feet.		
	M. V.	M. H.	M. A.	M. V.	M. H.	M. A.
Service-gallery practice ammunition:						
(a)	0.07	0.09	0.11	0.16	0.14	0.21
(b) .....	.11	.11	.16	.22	.13	.25
	.15	.11	.19	.32	.21	.39
	.12	.09	.15	.25	.31	.39
Mean .....	.11	.10	.15	.24	.20	.31
.22-caliber, long, rim-fire cartridges in model of 1903 rifle with special barrel rifled and chambered to take this cartridge .....	.11	.17	.20	.25	.22	.34
	.11	.15	.19	.20	.30	.36
Mean .....	.11	.16	.20	.23	.26	.35

	Accuracy (each target 10 shots).					
	75 feet.			100 feet.		
	M. V.	M. H.	M. A.	M. V.	M. H.	M. A.
Service-gallery practice ammunition:						
(a)	0.20	0.25	0.32	0.17	0.32	0.37
(b) .....	.50	.21	.54	.28	.20	.34
	.48	.30	.56	.44	.26	.51
	.40	.46	.61	.70	.49	.86
Mean .....	.40	.31	.51	.40	.32	.52
.22-caliber, long, rim-fire cartridges in model of 1903 rifle with special barrel rifled and chambered to take this cartridge31	.34	.46	.38	.34	.92
	.38	.58	.69	.61	.21	.64
Mean35	.46	.58	.50	.53	.78

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EXHIBIT B.

The board has met from time to time since the receipt of the foregoing letters and instructions ^a with all the members present.

FORT LEAVENWORTH, KANS., *September 28, 1905.*

The board met pursuant to the call of the president at 11.30 a. m.; present, Col. Chas. B. Hall, Eighteenth Infantry; Lieut. Col. Wm. Paulding, Eighteenth Infantry; Maj. Geo. S. Young, Eighteenth Infantry; Maj. D. L. Howell, Eighteenth Infantry; Capt. J. M. Arrasmith, Eighteenth Infantry, and Capt. Walter H. Gordon, Eighteenth Infantry.

The matters submitted to the board were fully considered. Its conclusions have been arrived at after careful deliberation, and they represent the unanimous views of the board.

The recorder was directed to procure the necessary miniature paper targets and 500 rounds of caliber .30 service-arms ammunition, carefully loaded by the post ordnance-sergeant for comparison, which was done.

A thorough experimental test was made of each, and the board is unanimously in favor of the adoption of the .22-caliber long cartridges for gallery practice, provided in the special barrels and receivers proposed for issue, the difficulty that the board found in loading the piece can be corrected.

In reaching this conclusion reference was made by the board to the foregoing letters ^a and especially to the letter from Capt. Jay E. Hoffer, Ordnance Department,

^a Not printed.

under date of September 16, 1905, in which it is believed the difficulty could be overcome by fitting to these special barrels regular receivers, in which the upper part has been entirely cut away, so as to enable the .22-caliber long ammunition to be readily inserted.

CHAS. B. HALL,
Colonel Eighteenth Infantry,
President.

WM. PAULDING,
Lieutenant-Colonel Eighteenth Infantry,
Member.

GEO. S. YOUNG,
Major Eighteenth Infantry,
Member.

D. L. HOWELL,
Major Eighteenth Infantry,
Member.

J. M. ARRASMITH,
Captain Eighteenth Infantry,
Member.

W. H. GORDON,
Captain and Adjutant Eighteenth Infantry,
Recorder.

APPENDIX VI.

CORRESPONDENCE RELATING TO THE ADOPTION OF INTRENCHING TOOLS FOR INFANTRY.

WASHINGTON, *May 6, 1905.*

The commandant of the engineer school, under date of March 14, 1905, submitted to the Chief of Engineers a report in the matter of intrenching tools (which report is appended hereto, marked A^a).

This report presents the following conclusions:

(a) The conclusions heretofore reached in the matter of intrenching tools for the equipment of all arms have been that the knife bayonet of the present small arm, together with the meat-ration can, tin cup or hands, formed a fairly efficient equipment for hasty entrenchment to the extent of providing individual cover, and that this equipment was available without adding to the weight to be carried habitually by the soldier; that a more efficient type of equipment of the "engineer pattern" of small intrenching shovel and pick mattock should be carried for each organization in its transportation of the first line, these tools being suitable also for transportation on the person and therefore available for carrying into action if so desired.

(b) The proposed substitution of a rod bayonet for the knife bayonet necessitated a reconsideration of the intrenching equipment, and until the type of bayonet for the new small arm is definitely adopted an intelligent revision of the proposed equipment can not be made. If the type of bayonet adopted for the new small arm should prove to be as efficient for intrenching as does the existing knife bayonet, then the present status could be continued and another tool need not be added to the soldier's equipment. On the contrary, if this bayonet should not be available for intrenching, or if the bayonet is to be entirely neglected in the consideration of an intrenching equipment, then the whole subject should be reconsidered with a view to providing a single tool for intrenching use.

(c) The merits and demerits of the knife bayonet as an intrenching tool are well known to the service. It is not entirely satisfactory as an intrenching tool and many objections have been made against it. Neither is it the best intrenching tool that can be carried by the soldier. It is, however, the only tool that can be made available to the soldier without increasing his burden. The selection of an intrenching tool, therefore, rests necessarily upon a decision as to whether the weight carried by the soldier is or is not to be increased to provide a more efficient tool than the bayonet. A better tool than the bayonet will weigh between 2 and 3 pounds and can be provided if required.

This report was returned to the commandant of the Engineer School with the following indorsement by the Chief of Staff, dated March 30, 1905:

It has been definitely decided to adopt the knife bayonet.

It has also been definitely decided that the bayonet shall not be considered as an intrenching tool. (See report of the special committee on the subject of the bayonet, copy herewith, which received the unanimous approval of the General Staff.)

The Chief of Staff desires that Major Burr now submit a report and special recommendation for an intrenching tool. This report to be ready at the earliest practicable date in order that the matter may be taken up by the General Staff and a decision rendered.

^aNot printed.

In accordance with the foregoing indorsement, Major Burr, on April 14, 1905, submitted a supplementary report (appended hereto, marked "B"^a), which contains the following recommendations:

The following alternate recommendations are therefore made, the choice between them resting upon a decision as to whether the soldiers' individual intrenching kits are or are not to be carried habitually on their persons:

(a) If the intrenching tool is to be carried habitually on the person of the soldier, an equipment similar to the Japanese is recommended with some minor alterations, viz, lengthen the handle of the shovel to a length over all of 24 inches instead of 20, for experiment; finish the handle with a cross or crutch instead of a ball, and roll the upper edge of the blade to give a better support for the foot; and give the blade a reasonable amount of "dish;" fit the handle to the pick-mattock in the manner customary in this country for commercial tools.

(b) If the intrenching tool is not to be carried habitually by the soldier, but is to be carried in the company transportation until contact is made with the enemy, an equipment of the small shovels and pick-mattocks, with hand axes and folding saws, is recommended. Even upon the assumption of company transportation for tools, it is evident that these intrenching tools, under modern conditions, must be carried by soldiers for considerable periods of time, particularly if that transportation is not most flexible and capable of keeping in close touch with the company. Weight should therefore be given to this recommendation accordingly, and in case of doubt recommendation (a) should be preferred. At the same time it is to be noted that while the bayonet of the new rifle is not to be considered as an intrenching tool, it will nevertheless be, without doubt, as efficient in that capacity as the present bayonet, and will be used by the soldier in emergencies, as was the old bayonet.

The reports (A^a and B^a) were referred to a special committee of the General Staff by the following memorandum:

To special committee composed of the following officers of the General Staff for prompt report: Major Mallory, Major Gaillard, Captain March, Captain Muir, and Captain McRae.

By order of the Chief of Staff:

BENJ. ALVORD,
Captain, General Staff, Secretary.

APRIL 18, 1905.

The committee met at 10 a. m., April 19, all the members being present, and proceeded to an investigation of the subject before it.

The commandant of the Engineer School was called upon to furnish the committee with specimens of the intrenching spade and pick-mattock referred to in his report, and with samples of any other intrenching tools which he might have investigated before rendering his report (A).^a

Capt. Peyton C. March, General Staff, made a report to the committee of his observations of the use of the intrenching tool by the Japanese army in the war in Manchuria, which is appended hereto, marked "C."^a

The committee then adjourned to meet April 20 at 10 a. m.

The committee met, pursuant to adjournment, at 10 a. m., April 20.

Capt. Carl Reichmann, Seventeenth Infantry, appeared before the committee and made a report upon the use of the intrenching tool by the Russian army in the Russo-Japanese war. This report is appended hereto, marked "D."^a

The committee also considered the intrenching tool used in the Davis pack, a model of which was examined; also the report of the Board of Ordnance and Fortification for 1903 and 1904, giving the results of their experiments with intrenching tools.

The committee then adjourned until 10 a. m., April 21, 1905.

^aNot printed.

Upon reassembling Maj. Edward Burr, Engineer Corps, commandant Engineer School, Washington Barracks, D. C., appeared before the committee with samples of the various tools referred to in his report and explained in detail the results of his experiments. He was requested to have prepared for the inspection of the committee the following:

One miner's shovel, length over all, 22 inches, one 24 inches, one 20 inches; the handle of one to be straight, the handle of another to have curves intermediate between the sample shown and a perfectly straight handle.

Also, one shovel with square blade like the Japanese, with the modifications suggested in Appendix B,^a if possible.

Also, a pick-mattock with 22-inch handle of the type of sample No. 1, herewith.

The following data concerning the types of intrenching tools used with foreign armies was laid before the committee:

CHINA RELIEF EXPEDITION.

BRITISH INDIAN.

The following intrenching tools are carried with each battalion of British Indian infantry:

- 8 axes.
- 80 picks.
- 40 billhooks.
- 60 shovels.

Three mules are allowed to each company and 8 for the two wings.

FRENCH.

The engineer soldiers are armed and equipped as infantry; strength of a company, peace 159, war 259.

The following loads are carried by the men of the engineer companies:

- 12 axes.
- 66 picks.
- 66 shovels.
- 4 folding saws.
- 12 hatchets (corporal's).
- rulers (sergeant's).

The present equipment of a company of infantry is entirely insufficient, since of the 200-250 men who may have to cover themselves during the course of the attack, 12 only are furnished with an intrenching tool.

On the defensive the company wagon can be drawn on. It furnishes 30 intrenching tools, etc.

JAPANESE.

The strength of an engineer company is 252. The following tools are carried by some of the men of the company:

- 6 axes.
- 80 shovels.
- 16 picks and combination picks and mattocks.

These men form three working parties.

RUSSIAN.

Actual strength about 200 men; theoretical strength about 225:

- 80 light spades.
- 20 light axes.
- 16 heavy spades.
- 8 heavy axes.
- 3 heavy mattocks.
- 1 crowbar.

^a Not printed.

GERMAN ARMY.

Corps.	For earthwork.				For timberwork.			For other work.
	Spades and shovels.		Pick-axes.	Picks.	Axes.	Hatchets.	Saws.	
	Large.	Small.						
Infantry or rifle battalion:								Tools and explosives for railway demolition, including 72 pounds of high explosive.
Wagons	20		10		8	14	4	
Men		400		40		20		
Cavalry regiment		32				48		
Field battery	33		31		14	32		
Horse battery	38		31		11	32		

FRANCE.

Carried by the men per company:

24 small spades.

1 saw.

8 pickaxes.

4 picks.

16 choppers.

Carried in the company wagons:

4 axes.

18 large spades.

2 knives.

4 saws.

12 pickaxes.

RUSSIA.

Carried by the men per infantry regiment of four battalions:

1,280 small spades.

320 hatchets.

Carried in the wagons per infantry regiment of four battalions:

256 large spades.

28 hatchets.

48 pickaxes.

16 crowbars.

AUSTRIA.

Company of infantry:

99 small spades.

2 felling axes.

2 cramp irons.

2 hand axes.

1 tool wallet.

2 shovels.

1 handsaw.

ITALY.

Infantry equipped with—

12 spades.

36 pickaxes.

6 saws.

12 axes.

In wagons, to the regiment—

36 spades.

36 pickaxes.

36 axes.

12 saws.

The portable intrenching spade in most armies is 20 to 21½ inches long, and weighs about 1 pound 10 ounces.

Comparing the total weight carried by the infantry soldier, the following table is given:

[Balck's Modern European Tactics, vol. 1, 1899.]

	Pounds.
Germany	66
Austria	61½
Italy	67½
France	61½
Russia	63
England	60
Switzerland	68½
Sweden	64
United States (proposed). (See Appendix F herewith. ^a)	

The committee then adjourned pending the preparation of the models requested of Major Burr.

The committee met at 2 p. m., April 25, and proceeded to Washington Barracks, D. C., where the samples of intrenching tools which Major Burr had been requested to make were carefully tested; also an intrenching spade captured at Tientsin, China, during the Boxer campaign, supposed to be of German make, and resembling in its essential characteristics the Japanese intrenching spade. These samples accompany this report.

Capt. G. H. McMaster, Twenty-fourth Infantry, appeared before the committee and explained his combined intrenching tool and wire cutter, exhibiting models.

The various tools were then tested in competition with each other, being handled by engineer soldiers. The ground was average hard ground with thick turf. The trenches constructed were of the "lying-down" type, 2 feet wide, 6 feet long, and 4 inches deep in front, sloping to 10 inches in depth at the rear, the earth in front being 1 foot high by 2½ feet wide at the top.

First test.—Construct lying-down trench, using intrenching spade only:

In this test the man using the German spade completed his work in 12 minutes and 12 seconds; the man using the No. 1 spade in 13 minutes and 10 seconds; the man using the McMaster intrenching tool in 15 minutes, with about two-thirds of the amount of protection in front which the others had.

Second test.—Construct lying-down trench, using pick and shovel:

Short-handled pick with shovel finished in 10 minutes; long-handled pick with spade in 12 minutes and 25 seconds.

The men who had used the German spade and No. 1 shovel then changed implements and worked for some time under direction of the committee, particular attention being paid to the length of handle and the relative ease of using the cross handle and the spherical end.

The samples of spades were then tested for strength by placing the point of the blade upon a brick, with the end of the handle resting on the ground, while a man first stood and then jumped up and down upon the handle. The handle was finally broken by a man jumping on it from a little distance. In no case was the blade bent or broken. The samples appeared, therefore, to have all the strength necessary for intrenching work.

^a Not printed.

As a result of their work with the tools of different lengths and types the engineer noncommissioned officers and privates pronounced individually in favor of the short pick-mattock with 22-inch handle and the pointed shovel 22 inches in length over all, and the cross or crutch in preference to the ball or spherical handle.

The committee then returned to the War Department, and adjourned to 10 a. m., April 27.

The committee reassembled at 10 a. m., April 27, 1905.

The questions connected with the general subject of intrenching tools were then taken up in the following order:

1. Shall an intrenching tool be carried on the person of the soldier?
2. What different kinds of intrenching tools shall be so carried?
3. What is the best type of each?
4. What proportion of each shall be carried by a company?

Considering "1. Shall an intrenching tool be carried on the person of the soldier?" the committee is unanimously of the opinion that an intrenching tool should be so carried.

In connection with this conclusion the committee considered an extract from proceedings of the Board of Ordnance and Fortification, dated January 8, 1903 (appended hereto, marked "E"^a), which shows the engineer equipment considered requisite for the several branches of the service on both a war and a peace footing. The equipment there proposed was intended to be carried habitually in the company pack or wagon transportation, but when necessary shovels and pick-mattocks of the types proposed could be carried on the person or on the horse of a mounted man.

This report was approved by the Secretary of War. It assumes the war strength of an infantry company at 150 men, and prescribes for them the following:

- 1 auger.
- 6 axes.
- 1 crowbar.
- 6 hatchets.
- 20 machetes with sheaths.
- 10 pounds assorted nails.
- 30 pick-mattocks with carriers.
- 10 wire-cutting pliers.
- 2 two-foot rules.
- 1 crosscut saw with sheath.
- 40 light shovels with carriers.
- 250 feet of 2½-inch rope.
- 2 odometers.
- 2 individual reconnoissance outfits.
- Total weight, 482 pounds.

It will be observed that the war strength of the company does not correspond with the strength prescribed in the Field Service Regulations, but it is assumed that proportional amounts of the various articles prescribed would be considered as the engineer equipment of an infantry organization as therein prescribed, to be carried in the company transportation.

While the recommendation of this committee that an intrenching tool be carried on the person of the soldier departs from the approved recommendation of the Board of Ordnance and Fortification quoted above, most of the articles there enumerated obviously could not be

^a Not printed.

carried anywhere except in wagons or packs, and the report specifically states that there is where they are all to be carried habitually.

A different class of tools, of size and weight suitable for carrying on the person, would therefore be required to carry out the recommendation of the committee.

Considering "2. What different kinds of intrenching tools shall be so carried?" the committee recommends the following:

Intrenching shovel.
Pick-mattock.
Hand ax.
Wire cutter.
Two-foot rule, folding.

Considering "3. What is the best type of each?" the committee recommends that a pick-mattock (model herewith) with 22-inch handle, and weighing 2 pounds 4 ounces, more or less, be adopted as the standard.

Upon further consideration of the proper type of intrenching shovel or spade, the committee requested that a model be constructed by Major Burr, as set forth in the following letter:

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, April 27, 1906.

SIR: The committee of the General Staff upon the general subject of intrenching tools requests that you will have constructed for their inspection one intrenching shovel of the type of No. 1, herewith, with the following modifications:

1. Replace the iron cross handle or clutch with a wooden cross handle, as in model No. 3, herewith.
2. Construct the reenforce—the upper and lower continuations of the blade along the handle—to the point indicated on the model. Upper and lower parts of the reenforce to be of the same length, instead of having the upper one longer than the lower, as on the present model. Also, a carrier for the pick-mattock with 22-inch handle, along the lines of the one sent for our inspection belonging to the regular engineer pick-mattock.

The committee requests that all models sent to you with this letter be returned with the finished articles, and would be glad to have them at the earliest practicable date.

Respectfully,

P. C. MARCH,
Captain, General Staff, Recorder.

Maj. EDWARD BURR,
Commandant Engineer School,
Washington Barracks, D. C.

Pending the receipt of this model, the committee adjourned to meet May 1, at 10 a. m.

The committee reassembled at 10 a. m., May 1.

The following letter from Major Burr, together with the models requested, was laid before the committee:

WAR DEPARTMENT, ENGINEER SCHOOL,
Washington Barracks, D. C., April 29, 1906.

SIR: In compliance with request of the 27th instant from the committee of the General Staff, subject, intrenching tools, there are transmitted to you to-day by messenger the following:

1. Remodeled picket shovel, 22 inches long over all, with wooden crutch handle instead of iron; also with the tangs of the shovel blade shortened as requested.

2. Small pick-mattock, furnished with leather sheath for carrying, as requested.

The remodeled shovel is in somewhat better shape than those previously furnished to you and weighs 29 ounces, where the shovel with the iron crutch weighs 31 ounces, a saving of 2 ounces. I do not consider the wooden crutch as strong and serviceable as the iron one, nor is it so well shaped to the hand in using the shovel. The difference in cost between the two should be very slight, if anything. My own opinion

favors the iron-crutch handle, which can probably be made somewhat lighter if desired. The tangs of the blade have been shortened as requested, but it is my personal opinion that they should be about 1 inch longer and secured with three rivets.

It is difficult to make this length from the picket shovels by reason of the spacing of the rivet holes in the latter, but it can be done if desired.

The sheath for the pick-mattock is slightly different from that now in your possession in that the cover for the pick end is carried high enough to bear upon the socket for the handle, thus taking the weight at that point and relieving it from the point of the pick, which is likely to wear through the leather.

An additional memorandum receipt, covering the remodeled shovel and the sheath for the pick-mattock, is transmitted herewith in duplicate, one copy of which may be retained by yourself.

The tools sent here with your letter of the 27th instant are also returned herewith.

Very respectfully,

EDW. BURR,
Major, Corps of Engineers, U. S. Army,
Commandant.

Maj. J. S. MALLOBY,
General Staff, U. S. Army,
War Department, Washington, D. C.

The committee then proceeded to a further consideration of the best type of intrenching spade to be adopted for the Army. After considering the various types of intrenching shovels and spades before the committee, all were finally rejected except model No. 4 and the German spade captured at Tientsin, both of which accompany this report. The model No. 4 is preferred to model No. 1, with the iron crutch handle, which is recommended by Major Burr, because it weighs less, and also for the reason that if the handle of No. 1 came off and was lost it would be practically impossible to use the shovel, while if the handle of No. 4 came out and was lost the soldier could always extemporize a crosspiece to insert in the eye of the handle.

It may be pointed out that the experiences of the most recent wars—the Russo-Japanese war and the Boer war—lead to the conclusion that trenches, to be of value against modern rifle and artillery fire, must be of the kneeling or standing type, and these can not be constructed with any variety of knife intrenching tool, except with the greatest difficulty.

The various types of combination intrenching tool—bayonet and wire cutter, etc.—known to the committee, while possessing merit, as compared with the knife bayonet alone used as an intrenching tool, can not compete with the spade and pick as used under modern conditions of fire action, and it is confidently predicted that after the first experience the American soldier has in a great battle he will place his intrenching tool on a par with his arms and ammunition.

The advantage of No. 4 rests in the superiority of its blade and the crutch handle for digging purposes, while the advantages of the German type are in the strength and simplicity of the handle, with consequent greater ease of carrying.

After maturely considering the advantages of each of these types, the committee recommends the adoption of the model No. 4, it being considered that its superior capacity for digging outweighs any other advantages that the German spade may possess.

It is recommended that a suitable carrier be constructed for this shovel; this matter to be taken up in connection with the subject of the proper pack to be carried by the soldier, as the place and method of carrying the shovel will depend upon the kind of pack adopted.

The shovel recommended (No. 4) may be described as a remodeled picket shovel with wooden crutch handle; the top edge of the blade to be square and turned forward five-sixteenths of an inch at right angles, to give better support for the foot: Weight, 29 ounces; length over all, 22 inches; length of blade, 8 inches; width of blade, $6\frac{1}{4}$ inches; dish of blade, $\frac{1}{8}$ inch.

It may be pointed out that the models submitted were made by hand at the engineer depot at Washington Barracks, and that the finished article, if adopted, would be smoother and neater in appearance.

The carrier submitted for the pick-mattock does not fulfill all the conditions necessary for permanently carrying the pick on the person. It was designed to carry the larger type of pick-mattock adopted by the Board of Ordnance and Fortification to be carried habitually upon the company transportation and only on the person in emergencies.

The question of the proper carrier and place of attachment of the pick-mattock should be considered in connection with carrying of clothing and other articles of equipment upon the person of the soldier, and it is so recommended.

If an intrenching spade and pick-mattock of the types proposed are adopted, it is manifest that the engineer equipment for the different arms of the service recommended by the Board of Ordnance and Fortification and approved by the Secretary of War (Appendix E, herewith^a) is in need of revision. It is not desirable to have a shovel and pick-mattock intermediate between the types here proposed and the larger picks and shovels of commerce, which can be carried on the company transportation and used when conditions permit.

The type of hand ax recommended for adoption may be described as follows (model herewith): Weight, 28 ounces; length over all, 15 $\frac{1}{2}$ inches.

This is the standard quartermaster's camp hatchet, and there are at present on hand in the depot at Philadelphia 1,800 of them—enough to equip the entire infantry arm of the service.

The proper carrier for this ax should be determined by experiment, in connection with the question of the proper pack for the soldier, as in the case of the spade and pick-mattock.

The type of wire cutter recommended for adoption is known as the "button plier" (model herewith). This is 10 inches long, weighs 1 pound, and costs 35 cents. A large number of these were used during the war with Spain, and the type is well known to the service.

The 2-foot rule recommended is the ordinary folding 2-foot rule of commerce.

Considering "4. What number of each shall be carried by a company?" the committee recommends the following for a company of infantry on a war footing, or of any other arm serving as infantry:

Articles.	Carried by—	Weight.	Length.
		Lbs. oz.	Inches.
One 2-foot rule, folding	First sergeant		
Four hand axes	{ 1 musician	0 28	15 $\frac{1}{2}$
	{ 3 duty sergeants		
Three wire cutters	3 duty sergeants	1 0	10
One pick-mattock	{ To each squad	0 36	22
Three intrenching shovels		0 29	22

^a Not printed.

The scheme outlined above gives one relief throughout the organization for all tools, and it is assumed that the men would alternate daily in carrying them on the march. The duty sergeants might alternate in carrying the hand axes and the wire cutters, as the weights differ. The scheme provides for responsibility for and supervision of all tools by an officer or noncommissioned officer—the corporal for the tools of his squad, the sergeants for the tools carried by themselves, and the commanding officer for the musicians'.

Special attention is invited to the reports of the military attachés with the Russian and Japanese armies (Appendices C^a and D^a), and also to the extract from the report of Colonel Wagner, chief umpire, on the Maneuvers of 1903 (Appendix G^a).

The lying-down trench has been shown by practical experience in the Manchurian war to be of little or no value in modern fighting, and has been so reported by the observers on both sides. This fact has been of first importance in determining the type of intrenching tool to be recommended.

This committee has considered the question of the intrenching tools to be carried on the person as one for the infantry arm of the service alone. The report of the Board of Ordnance and Fortification (Appendix E^a), subject to the revision herein recommended, will provide the number of tools of all kinds suitable for other arms of the service, and to be carried on their transportation.

JOHN S. MALLORY,
Major, General Staff.

D. D. GAILLARD,
Major, General Staff.

CHARLES H. MUTR,
Captain, General Staff.

J. H. McRAE,
Captain, General Staff.

P. C. MARCH,
Captain, General Staff.

4606—328.

MEMORANDUM FOR THE SECRETARY OF WAR.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, May 23, 1905.

For several years there has been much talk in the Army, and I may say considerable effort also, to secure proper intrenching tools for the soldier—intrenching tools of the sort to be carried upon his person when about to engage in battle. Chiefly the efforts have taken the direction of compromise or combination—that is to say, the bayonet to also be used as an intrenching tool and the meat-ration can to serve also as a shovel, the object being to reduce, or at least not add to, the weight to be carried by the soldier. None of these efforts has ever

amounted to a substantial advance toward suitable intrenching tools. The question has been recently referred to a special committee of the General Staff to make a report, and that report has been acted upon by the General Staff in committee, with the result that it recommends the adoption of a small shovel, a pick mattock, a hatchet, and cutting plyers, none of which, it will be noted, is a combination tool, each being simple and useful in itself.

I recommend that the Secretary of War approve the conclusions of the General Staff in the matter, and that these articles be designated as a part of the soldier's equipment, to be manufactured and issued by the Ordnance Department.

The scheme of supply is 1 pick and 3 shovels to each squad of 8 men; 4 hand axes per company, to be carried by 1 musician and 3 duty sergeants; 3 wire cutters, to be carried by 3 duty sergeants. With this distribution the number for a company of infantry on a war footing (128 men) would be 4 axes, 3 wire cutters, 14 pick mattocks, 42 shovels. The hand axe weighs 28 ounces, the wire cutter 1 pound, the pick mattock 36 ounces, and the shovel 29 ounces. Including one day's ration, 100 rounds of ammunition and a rifle, and the various other articles which a soldier needs and sometimes carries, and excluding the weight of clothing worn by the soldier upon his person, the total weight at present prescribed is approximately 45 pounds. Add to this the heaviest of these proposed tools, which is the pick mattock, and the weight will be 47 pounds 4 ounces.

It is of the greatest importance that our Army be supplied with suitable intrenching tools, and I am satisfied that the ones adopted by the General Staff as nearly meet the demand as any that can be devised.

Respectfully,

CHAFFEE,
Lieutenant-General, Chief of Staff.

MAY 23, 1905.

Approved.

Send this report and the tools to the President for his examination and ruling.

WM. H. TAFT,
Secretary of War.

4606-328-4.

THE WHITE HOUSE,
Washington, May 23, 1905.

MY DEAR MR. SECRETARY: I return herewith the memorandum of the Chief of Staff, dated the 23d instant, transmitting the report of the commandant of the Engineer School on the matter of intrenching tools. The report and the tools seem to the President to be just right. Could the President keep the set of tools?

Very truly, yours,

WM. LOEB, JR.,
Secretary to the President.

Hon. W. H. TAFT,
Secretary of War.

4606-328-5.

[First indorsement.]

WAR DEPARTMENT,
THE MILITARY SECRETARY'S OFFICE,
Washington, May 26, 1906.

Respectfully referred to the Chief of Ordnance, inviting attention to this report and the approval of same by the Secretary of War; also to the note of the President, expressing concurrence upon the suitability of the intrenching tools adopted.

The Chief of Ordnance should take immediate steps for the manufacture of tools for issue to the Army and for procuring a reasonable reserve, for issue to the volunteers in the event of war; say, 100,000 shovels, and a proper proportion of pick mattocks, etc., for the reserve.

As soon as a sufficient number is manufactured to equip the infantry of the Army, it is desired that the Chief of Ordnance report the fact to the Chief of Staff, with a view to an order issuing for their distribution.

By direction of the Chief of Staff:

HENRY P. MCCAIN,
Military Secretary.

APPENDIX VII.

RESULTS OF FIRING WITH 12-INCH CAST-IRON, STEEL-HOOPED MORTAR, MODEL OF 1886.

(5 plates.)

THE ORDNANCE BOARD, U. S. ARMY,
NEW YORK ARSENAL,
GOVERNORS ISLAND, NEW YORK HARBOR,
New York City, September 20, 1905.

SIR: 1. In obedience to instructions in O. O. 37438-28, the Board respectfully reports the results of the firing of 88 rounds of 12-inch cast-iron, steel-hooped mortar, model of 1886, at Battery Reynolds, after firing 16 rounds at the proof battery for powder characteristics, in order to determine zones and ballistic data for 1,046 and 824 pound capped shell.

2. The following papers, forming part of the report, are attached:

Firing records of 104 rounds.

Table of complete ballistic data for each round of the test.

Curves showing relations of powder charges, pressures, and muzzle velocities.

Curves showing relations between quadrant elevations and ranges for seven muzzle velocities.

Curves showing relations between muzzle velocities and ranges for six quadrant elevations.

Curves showing drift as a function of the range for seven muzzle velocities.

Tables of zone dimensions for cast-iron and deck-piercing capped shell.

3. The service velocities prescribed for full charges with projectiles of the standard weights, 1,046 and 824 pounds, are 950 and 1,050 feet per second, to be obtained with a powder pressure not exceeding 27,500 pounds per square inch and a smokeless powder charge, exclusive of igniter charge, not exceeding 33 pounds. Pending the manufacture of a special powder for the 12-inch cast-iron, steel-hooped mortar, L. & R., lot 6, 1902, for the 15-pounder rapid-fire gun was used, with the provision that the maximum powder charge, exclusive of igniter, shall not exceed 33 pounds with the heavier projectile, or 34.5 pounds with the lighter one, and also that a pressure of 29,000 pounds per square inch shall not be exceeded. The powder to be brought to 70° temperature for firing.

In order to obtain as full data as practicable for both drill and battle projectiles, 46 cast-iron and 26 deck-piercing steel 1,046-pound capped shell were fired with six different initial velocities and 10 cast-iron and 6 deck-piercing 824-pound capped shell were fired at a single velocity for the greatest range.

Dummy cast-iron caps were put on both kinds of cast-iron projectiles in conformity with O. O. drawing 25, div. 14, cl. 75. They are larger

than the deck-piercing caps and differ from these in shape. They were assembled on the projectiles by 60 tons pressure from an hydraulic jack after the threads on their shanks had been turned down to fit a hole bored in the ogive.

4. Prior to the test the settings of the verniers on the mortars were tested and corrected. The mortars and range-finders used were surveyed and located on the proving ground's plotting board. The line of fire was established by computation, plotted, and then checked by taking observations from three of the proving-ground range-finders on a flag set on the line of fire.

5. The firings were conducted as prescribed by Ordnance Board Programme 284, as revised February 4, 1905. All firings were made with the powder at 70° temperature and the projectiles were ballasted with asphalt. Effort was made to obtain trustworthy data. The weighing of projectiles and charges were verified and the laying of the mortars was checked by Lieutenant Hawkins, Ordnance Department, who conducted the firings. Observations were made on all the splashes by observers with azimuth instruments in the four range-finding stations having 1,000, 2,400, and 4,400 yard base lines, by one observer with a Warner & Swasey D. P. F. instrument 60 feet high, and a short distance in rear of the mortar, and by a sixth observer with the Warner & Swasey D. P. F. instrument 60 feet high, in Battery Halleck range tower, during 18 rounds. Hence there were five observations on every splash and six on some of the splashes. The intersections were generally good. Wind velocity and direction were taken from the readings of Weather Bureau self-registering anemometer and vane. The temperature, pressure, and humidity of the air were taken by means of the proving ground's instruments, which are in constant service.

6. The flight of many projectiles could be seen at different parts of the trajectory, but not always continuously, by means of field glasses in rear of the piece. All projectiles seen in the first half of the trajectory were steady or approaching steadiness. In the second half all projectiles with high velocities or low departures were fairly steady, but when the velocity was low and the angle of departure high the axis of the projectile was seen inclined to the plane of the trajectory with the point to the right or left, sometimes as much as 20° . By holding the glass with the lowest point of the field on the striking point in the water and waiting for a shot to cross the field several shells were seen to fall as shown. The observations appeared to indicate gyratory motion. But no one projectile was seen to turn to the extent that the point would pass from the right of the plane of fire to the left, or vice versa.

7. The mean of the pressures obtained with firings of the test at Battery Reynolds was lower than that obtained in the preliminary firings at the proof battery for velocity and pressure with the same weight, kind of powder, and projectile. Precautions were taken during the test to keep the powder at the same temperature of 70° by hauling, as required, to the mortar, one-half mile distant from the heating chamber, each charge of powder in a box warmed by hot brick. It was not always practicable to insert the charge upon arrival, or, having inserted it, to fire at once. Difference in temperature of the

powder and difference between the two mortars used for the proof of powder and the test may account for the difference of pressures. Velocities for the zones were, therefore, found by referring back from the mean pressure curve to the corresponding points on the pressure and velocity curves of the preliminary firings. It was thus found that the 560 feet per second velocity was 8 feet per second short, the 625 feet per second velocity 12 feet per second short, the 700 feet per second velocity 14 feet per second short, the 805 feet per second velocity 11 feet per second short, and the 950 feet per second velocity 0 foot per second short.

8. For the same velocity and elevation uniformly greater ranges were obtained from the deck-piercing steel shell than from the same weights of cast-iron shell. This can only be accounted for by the difference in the profile and weight of the caps.

9. The set of curves showing both for cast-iron and steel shell the relations between muzzle velocities and ranges for various elevations will facilitate the division of the field of fire of the cast-iron mortar into zones. A division is made showing seven zones—six for the 1,046-pound and one for the 824-pound projectile. Each of the zones for the steel deck-piercing shell differs slightly from the one having the same corrected velocity for the cast-iron shell, owing to the greater range of the former.

10. The following tables give the width of the zones and the weights of the charges for the same made up in aliquot parts. The charge for the seventh zone could not be made in aliquot part and keep the range and pressure within the prescribed limits. If a pressure of 29,600 pounds were permissible, the charge for the seventh zone could be made in aliquot parts. It was sought to have the overlaps of the successive zones increase gradually in width outward and to avoid excessive overlaps. The number of packages of powder required for any zone covered by the 1,046-pound projectile is equal to the number of the zone, a disposition which should lessen the chance of making a mistake in loading.

Zones for 12-inch cast-iron, steel-hooped mortar, model of 1886.

CAST-IRON SHELL, CAPPED.

No. of zone.	Weight of projectile.	Muzzle velocity.	Elevations.	Ranges.	Overlaps.	Charge.	Aliquot parts.	Pressure per square inch.
	<i>Pounds.</i>	<i>Ft. sec.</i>	<i>° °</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Lbs. oz.</i>		<i>Pounds.</i>
1	1,046	560	45-65	2,240- 3,040	180	12 15.4	A	8,450
2	1,046	643	45-65	2,860- 3,860	280	16 6.3	A + B	11,500
3	1,046	727	45-65	3,580- 4,800	420	19 13.2	A + 2B	15,000
4	1,046	804	45-65	4,380- 5,740	490	23 4.1	A + 3B	19,000
5	1,046	875	45-65	5,250- 6,660	310	26 11.0	A + 4B	23,800
6	1,046	950	45-65	6,350- 7,610	710	30 1.9	A + 5B	29,000
7	824	1,050	45-65	6,900- 9,480	140	31 11.0	C	26,800
7	824	1,110	45-65	7,750-10,360		33 8.8	A + 6B	29,600

Zones for 12-inch cast-iron, steel-hooped mortar, model of 1886—Continued.

DECK-PIERCING SHELL, CAPPED.

No. of zone.	Weight of projectile.	Muzzle velocity.	Elevations.	Ranges.	Overlaps.	Charge.	Aliquot parts.	Pressure per square inch.
	<i>Pounds.</i>	<i>Ft. sec.</i>	<i>° °</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Lbs. oz.</i>		<i>Pounds.</i>
1	1,046	560	45-65	2,320- 3,150	220	12 15.4	A	8,450
2	1,046	643	45-65	2,930- 3,930	270	16 6.8	A + B	11,500
3	1,046	727	45-65	3,660- 4,900	520	19 13.2	A + 2B	15,000
4	1,046	804	45-65	4,380- 5,740	390	23 4.1	A + 3B	19,000
5	1,046	875	45-65	5,350- 6,850	360	26 11.0	A + 4B	23,800
6	1,046	950	45-65	6,490- 7,960	740	30 1.9	A + 5B	29,000
7	824	1,050	45-65	7,220- 9,720	120	31 11.0	C	25,800
7	824	1,110	45-65	8,060-10,600		33 8.8	A + 6B	29,800

A = 12 pounds 15.4 ounces. B = 3 pounds 6.9 ounces = 26.47 per cent of A. C = 31 pounds 11 ounces = 244.45 per cent of A. Above charges, pressures, etc., pertain to Laffin & Rand smokeless powder, lot 6, 1902, for 15-pounder rapid-fire gun.

11. But the zones for target practice should be the same as those for battle. To obtain them it will be necessary to diminish to a small extent the width of the zones and the amount of overlap as given above.

The table for service then becomes for the above division as follows:

Zones for both cast-iron and deck-piercing capped shell, 12-inch cast-iron mortar, 1886.

No. of zone.	Weight of projectile.	Muzzle velocity.	Elevations.	Ranges.	Overlaps.	Charge.	Aliquot parts.	Pressure per square inch.
	<i>Pounds.</i>	<i>Ft. sec.</i>	<i>° °</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Lbs. oz.</i>		<i>Pounds.</i>
1	1,046	560	45-65	2,320- 3,040	110	12 5.4	A	8,450
2	1,046	643	45-65	2,930- 3,860	200	16 6.8	A + B	11,500
3	1,046	727	45-65	3,660- 4,800	420	19 13.2	A + 2B	12,000
4	1,046	804	45-65	4,380- 5,740	390	23 4.1	A + 3B	19,000
5	1,046	875	45-65	5,350- 6,660	170	26 11.0	A + 4B	23,800
6	1,046	950	45-65	6,490- 7,610	390	30 1.9	A + 5B	29,000
7	824	1,050	45-65	7,220- 9,720		31 11.0	C	25,800
7	824	1,110	45-65	8,060-10,360		33 8.8	A + 6B	29,600

A = 12 $\frac{15}{16}$ pounds. B = 3 $\frac{11}{16}$ pounds. C = 31 $\frac{11}{16}$ pounds. Laffin & Rand, lot 6, 1902, for 15-pounder rapid fire.

12. Other arrangements of zones than the one selected can be taken from the data furnished. Range tables may be computed with other divisions, which would give any desired overlap for prediction or would show the charges necessary to cover the zones and meet local conditions, or would indicate charges divisible into other aliquot parts.

13. The characteristic curve of the provisional powder used gave the 1,046-pound projectile 950 feet per second with 29,000 pounds

per square inch by using $30\frac{1}{4}$ pounds charge, and 824-pound projectile 1,050 feet per second with 26,800 pounds per square inch by using $31\frac{1}{4}$ pounds charge. These charges are exclusive of igniter.

A much less range than 2,320 yards can not be obtained by means of a low velocity at 65° elevation, owing to unsteadiness of the projectile. The only advantage of the special powder will then be to extend the outer range of 9,720 yards. The two limiting ranges obtained with the 15-pounder powder for which zones and ballistic data are given are not far from suitable limits for the cast-iron mortar.

14. From 65° to 45° in every zone the drift starting on the right of the plane of fire begins after a time to approach it. There was no abrupt change of drift. The decrease of drift to the right with increase of range resembled that of the 12-inch steel mortar with deck-piercing and mortar shell for ranges beyond the 65° angle of elevation, as shown in the report of the Chief of Ordnance, 1904.

15. The only additional experiment connected with the foregoing firings was made to duplicate, if possible, the premature firing of primers with lanyards attached in adjoining mortars, as reported from certain artillery posts. Fifty-three attempts involving all reasonable disposition which could be suggested failed to afford a premature discharge. Report was forwarded by second indorsement July 19, 1905, on O. B. 63-148.

Very respectfully,

CHAS. S. SMITH,
Colonel, Ordnance Department, U. S. Army,
President.

R. BIRNIE,
Major, Ordnance Department, U. S. Army.

GEO. L. ANDERSON,
Major, Artillery Corps, U. S. Army.

Major Dunn absent.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

(Inclosures as enumerated in second paragraph.)
37438-310.

[First indorsement.]

OFFICE OF THE CHIEF OF ORDNANCE,
Washington, September 30, 1905.

1. Respectfully referred to the Chief of Artillery for his information, requesting a return of these papers when they are no longer required.

2. Similar information in regard to the 12-inch steel mortar was sent him April 21, 1905. (O. O. 26215-282.)

C. B. WHEELER,
Captain, Ordnance Department, Acting Chief of Ordnance.

[Second indorsement.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ARTILLERY,
Washington, January 3, 1905.

Respectfully returned to the Chief of Ordnance, U. S. Army, noted.
These papers have also received the consideration of the Artillery
Board.

SAML. M. MILLS,
Brigadier-General, Chief of Artillery.

of 1886, at Sandy Hook Proving Ground, N. J., from March 13 to 16, 1905.

and 950 feet per second velocity with 1,046-pound projectile and 1,050 feet per pound projectile.]

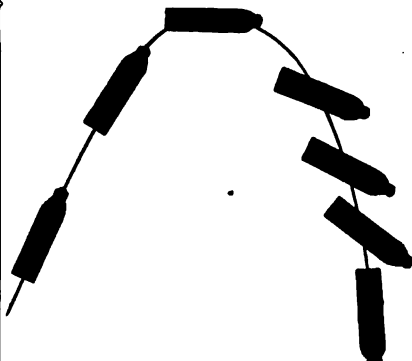
Counter recoil.	Wind, strength, and direction.	Temperature of powder.	Gun loaded.	Gun fired.	Special remarks.	General remarks.
In. 32½	March 13, wind east, 5 miles an hour; barometer, 30.349; thermometer, 36; humidity, 55. March 14, wind southeast, 10 miles an hour; barometer, 30.349; thermometer, 36; humidity, 53. March 15, wind southeast, 10 miles an hour; barometer, 30.563; thermometer, 36; humidity, 58. March 16, wind southeast, 10 miles an hour; barometer, 30.563; thermometer, 36; humidity, 58.	°F. 70	3.00	3.01	0000 F. A. coppers, May, 1901.	
34		70	3.43	3.44	9,000 I. C. coppers, F. A., May, 1901. No records on register rods in instrument room.	
1		70	9.19	9.21		
2		70	9.41	9.42	14,000 I. C. F. A. coppers, May, 1901.	
.....		70	10.15	10.16	18,000 I. C. F. A. coppers, May, 1901.	
.....		70	10.34	10.35		
1		70	11.18	11.19		Mortar mounted on 12-inch barbette carriage No. 9, W. A., model 1892. Obturating friction primers used. Fired to sea.
.....		70	11.37	11.38	24,000 I. C. F. A. coppers, May, 1901.	The base of these shot were turned off in order to bring the shot to 1,046 pounds weight. Powder placed in heating chamber on Feb. 20, 1905. Charges brought out to gun in a man's arms.
1		70	11.53	11.54		Mortar was forced fully into battery after each round.
.....		70	4.10	4.12		These projectiles were tried with the maximum and minimum gauges, and it was found that the maximum gauge passed over the projectile with a close sliding fit, and that the minimum gauge would not be passed over the projectile.
1		70	10.17	10.19	9,000 I. C. F. A. coppers, May, 1901.	Firing conducted by Lieut. W. J. Hawkins, Ordnance Department.
1		73	10.40	10.41	0000 I. C. F. A. coppers, May, 1901.	
.....		70	10.01	10.02	9,000 I. C. F. A. coppers, May, 1901.	
1		70	10.23	10.24	18,000 I. C. F. A. coppers, November, 1900.	
35		70	10.55	10.56		
.....		70	11.14	11.15	24,000 I. C. F. A. coppers, May, 1901.	

CHAS. S. SMITH,

Colonel, Ordnance Department, U. S. A.

of fi

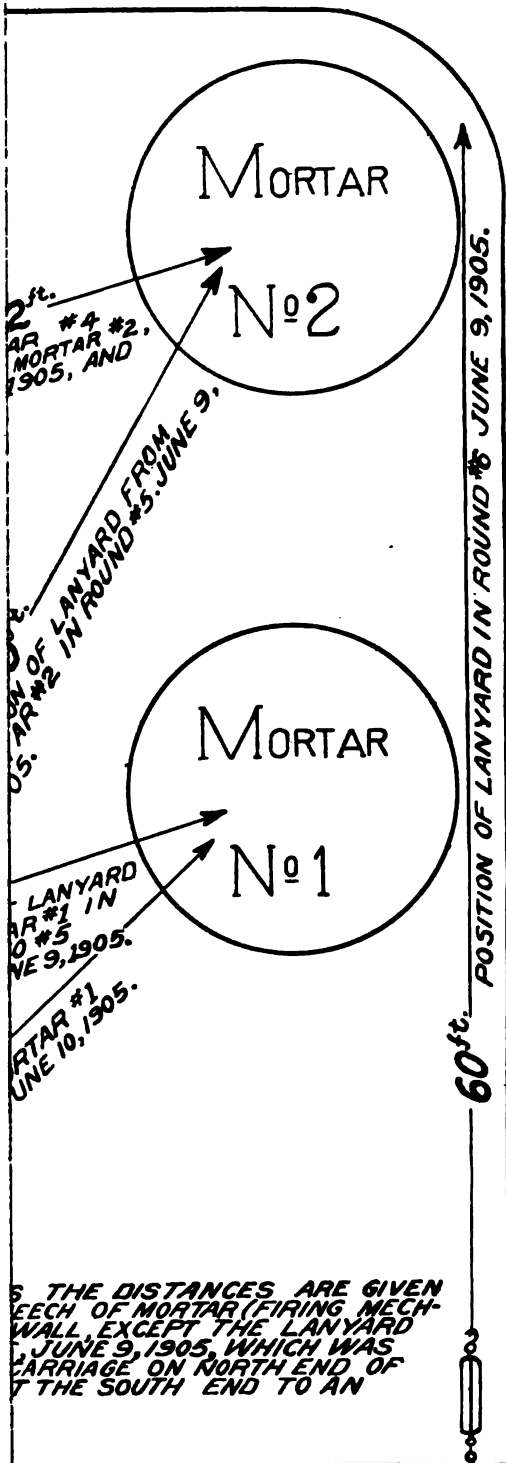
—
Azim
of l
of f
—

Azimuth of line of fire.	Temperature of powder.	Remarks.	General remarks.
° 310	° F. 70	failed electrically. Contact jaws securely.	
294	70		
294	70		Mortar No. 15 (No. 1 in pit) mounted on 12-inch mortar carriage No. 14, model 1891. Combination electric and friction primers used. Fired to sea electrically. Horney firing mechanism No. 4, model 1903, used in rounds 1, 2, and 3.
294	70		Position of throttling plugs, counted from top: First, open; second, quarter open; third, quarter open; fourth, open; fifth, open; sixth, closed; seventh, closed.
294	70	have a slight wobble all from the summit's longitudinal axis down.	Powder was kept at 70° F. while in transit from heating chamber by means of heated bricks placed in chests in which the powder was transported.
294	70	as to the steadiness	Powder placed in heating chamber on Mar. 15, 1905, and was brought out to mortar as stated above.
294	70		The D. P. shell were weighed to 1,046 pounds with asphalt and a central lead cylinder at the base of the projectile to simulate the stock of a detonating fuse in weight and position.
294	70	in its flight by two the flight of the projectile struck water ectile did not fully axis and bring its to the trajectory un- its full. See sketch.	Present May 2, 1905: Maj. R. Birnie, Ordnance Department; Maj. G. L. Anderson, Artillery Corps.
294	70	with lower field at een at the top of the ertical, point down. as a little to the left.	Present May 8, 1905: Maj. G. L. Anderson, Artillery Corps.
294	70		Firing mechanism belonging to mortar at Fort Hancock used in rounds 4 to 17, inclusive.
294	70		
294	70		
294	70		
294	70		
294	70	When the projec- gitudinal axis ap- to the plane of the projectile being in-	Diagram of position of projectile during flight, rounds 6, 9, and 10.
294	70		Projectiles wiped off with oily waste before load- ing each round, also gauged with maximum and minimum gauges.
294	70	perceived during the t time the projectie ne plane of fire, the o the left than the	

Azimuth of line of fire.	Tem- pera- ture of pow- der.	Eleva- tion	Remarks.	General remarks.
° 294	° F. 70	°		
294	70			<p>Azimuth noted in column 10 is true azimuth measured from the true south in a clockwise direction.</p> <p>Observations were made on the splash at each round with the two azimuth instruments at the proof battery, the instrument at beach tower No. 1, the instrument at beach tower No. 2, and the Warner & Swasey D. P. F. instrument in the range tower at Battery Reynolds.</p> <p>In rounds 1, 2, 5-8, and 10, observations on the splash were also made with D. P. F. instrument at Battery Halleck. This instrument was not used in all rounds on account of the depleted garrison at Fort Hancock during the artillery maneuvers.</p> <p>The shots were plotted on the old plotting board, as the new one has no arm from the Halleck station, nor are the mortars at Reynolds located on it.</p> <p>The cuts and intersections were good.</p> <p>Firing conducted by Lieut. W. J. Hawkins, Ordnance Department.</p>
294	70			
294	70			
294	70			
294	70			

CHAS. S. SMITH,
Colonel, Ordnance Department, U. S. A.,
Commanding.

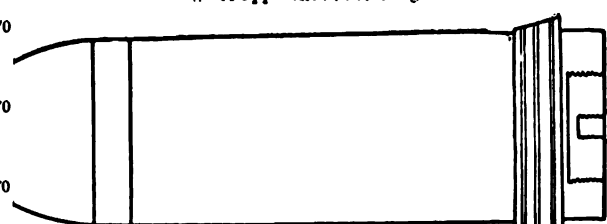
WILFORD J. HAWKINS,
Lieutenant, Ordnance Department, U. S. A.,
Assistant Proof Officer.



Azimuth of line of fire.	Temperature marks. powder.	General remarks.
294	70° F. curved throughout its flight. The longitudinal axis of the projectile was constantly parallel to the line of fire.	Mortar No. 15 (No. 1 in pit) mounted on 12-inch mortar carriage No. 14, model of 1891. Firing mechanism belonging to mortar at Fort Hancock used in rounds 18 to 53, inclusive. In rounds 25, 27-29, 31-33, observations on the splash were made with D. P. F. instrument at Battery Halleck. This instrument was not used in all rounds on account of the depleted garrison at Fort Hancock during the artillery maneuvers. Mortar No. 20 (No. 3 in pit) mounted on spring return mortar carriage No. 4, model of 1891, B. I. F. Mortars Nos. 1, 2, and 4 (pit numbers) set at the same azimuth and elevation as mortar No. 3, and primer inserted and lanyard attached, the lanyard being an initial tension of 10 pounds. Spring balances were used on the lanyard in such a way as to register the initial pull and any subsequent pull due to blast effect on the firing of mortar No. 3. Rounds 24 to 53, inclusive, fired by lanyard. Powder used in rounds 24 to 29, inclusive, placed in heating chamber on June 3, 1905. Charges were brought to gun in a box. Present June 9, 1905: Maj. G. L. Anderson, Artillery Corps.
294	70°	
294	70° primer failed electrically.	
294	70°	
294	70° was observed with a slight reluctance in bringing the projectile parallel to the line of fire as was noted.	
294	70° not become parallel about 40 seconds of the flight.	
294	70° fired. Stem was bent five 0.1-inch motion. not fired. Stem not in mortar No. 4 same as No. 3. Gun rendered it impossible of the projectile.	
294	70° fired. Stem bent and travel of about 1/4 inch. not fired. Stem loosened about 1/4 inch. same as No. 2. The primer to be steady up to tory, where it was lost.	
294	70° not fired. Stem bent about 0.1 inch in its seat. No. 2 not fired. Stem loose, so that it had a slight movement in its seat. Primer in. Stem slightly bent at, so that it had a slight movement in its seat.	
294	70° the tension was ascertained in mortar No. 4. rounds. No spring tension in mortar No. 1, but spring tension by a "sheep-shank" did fit in its seat and on. Primer in mortar bent and loosened, so about 0.1 inch in its seat. No. 2 not affected. not fired. Stem loosened 1/4 inch travel in its seat.	
294	70° short lanyard loose. No primer in mortar No. 2 not in its seat, so as to have primer in mortar No. 4 in its seat, so as to have 1 inch.	

Azimuth of line of fire.	Temperature of powder.	Elevations.	General remarks.
°	° F.		
294	72		ound a lanyard was d of the pit to north rd being about 60 llel to the east wall rs 1 and 3. This po s thought that the uld be obtained at r which the mortar r was fired this lan- te with a wide am- parallel to the line of anyard being about o. 2 not fired. Stem travel of about 0.1 p. 4 same as No. 2. d 4 not fired. Lan- attached to spring. as shown in sketch
294	70		
294	72		
194	72		
M	72		
i	70		red. Impossible to n account of cloud
	70		red. The flight of roughout its flight its flight appeared ectile showed the g its longitudinal tory as was noted
	70		red. The flight of d appeared steady, all the longitudinal hed to the plane of e to the left by an
	70		red. Further re- p. 35.
	70		red. Further re- No. 38, except that he right.
	70		red. Remarks same
	69		
	69		
	69		

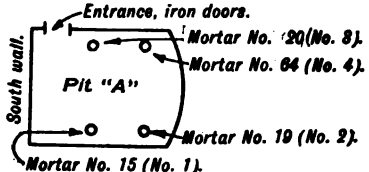
Mortar No. 15 (No. 1 in pit) mounted on 12-inch spring return mortar carriage No. 14, model of 1891, B. I. F.
Mortar No. 20 (No. 3 in pit) mounted on 12-inch spring return mortar carriage No. 4, model of 1891, B. I. F.
Projectiles used in rounds 30 to 53, inclusive, were provided with dummy caps as per drawing. (See p. 166.)
Powder used in rounds 30 to 53, inclusive, placed in heating chamber on June 9, 1905.
Combination electric and friction primers with rear insulation modified Oct. 5, 1904, used in rounds 35 to 53, inclusive, only.
Present June 22, 1905: Maj. G. L. Anderson, Artillery Corps.
Mortar No. 64 (No. 4 in pit).

Asimuth of line of fire.	Tem- pera- ture of rks. pow- der.	General remarks.
°	° F.	
294	70	Mortar No. 15 (No. 1 in pit) mounted on carriage No. 14.
294	70	Mortar No. 20 (No. 3 in pit) mounted on carriage No. 4.
294	70	In rounds 49, 50, and 53 flight of projectile was observed and appeared steady, but during its last part of fall, the longitudinal axis of projectile was inclined to the plane of fire, with point of projectile to the right by an angle of about 15° or 20°.
294	70	At elevations of 55°, 50°, and 45° the longitudinal axis of the projectile appears to remain nearly parallel to the trajectory throughout its flight, and at these elevations the reluctance of the projectile to bring its longitudinal axis parallel to the trajectory after leaving the summit is not so apparent at these higher elevations.
294	70	
294	70	
294	70	
294	70	
294	70	For this firing of June 24, 1905, mortars Nos. 15 and 20 (1 and 3 in pit) were loaded at the same time and lanyards were attached, after which the mortars were fired singly, and no sympathetic firing resulted either by firing No. 1 first or No. 3 first.
294	70	12-inch D. P. mortar shell, model 1898, 1,046 pounds. See drawing No. 4, class 75, division 12.
294	70	12-inch D. P. mortar shell, model 1898, 824 pounds. See drawing No. 3, class 75, division 12.
294	70	12-inch mortar shell, C. I., 1,046 pounds. See drawing No. 2, class 75, division 12.
294	70	12-inch mortar shell, C. I., 824 pounds. See drawing No. 1, class 75, division 12.
294	70	C. I. caps for 800 and 1,000 pounds C. I. shell. See drawing No. 25, class 75, division 14.
294	70	Firing conducted by Lieut. W. J. Hawkins, Ordnance Department.

CHAS. S. SMITH,
Colonel, Ordnance Department, U. S. A.,
Commanding.

WILFORD J. HAWKINS,
Lieutenant, Ordnance Department, U. S. A.,
Assistant Proof Officer.

No. of	Elev. on barometer.	Remarks.	General remarks.
1	30.097		
2	30.097		
3	30.089	arent wabble as it left ctile was lost to view mit.	
4	30.084		
5	30.084		
6	30.081	off its threads and was at this round.	Mortar No. 15, mounted on carriage No. 14; mortar No. 19, on carriage No. 15; mortar No. 20, on carriage No. 4; mortar No. 64, on carriage No. 16. Firing mechanism belonging to mortar at Fort Hancock used in rounds 51 to 88, inclusive. Rounds 51 to 88, inclusive, fired by lanyard. Projectiles used in rounds 51 to 88, inclusive, were provided with dummy caps as per drawing. (See p. 166.) Powder used in rounds 51 to 88, inclusive, placed in heating chamber June 9, 1906. Combination electric and friction primers, with rear insulation, modified Oct. 5, 1904, used in rounds 51 to 58, inclusive, only. For rounds 59 to 65, inclusive, the lanyard was attached to mortar No. 2, same as on June 9, 1906. (See sketch.) Initial pull on lanyard 8 pounds, no spring balance attached. The primer was not fired in any of the rounds.
7	30.081	ead on left hand side ly counter recoil until adwheels are loosened	
8	29.874		
9	29.874		
10	29.874	ired the same as in pre- vation, but while it ap- projectile showed a re- gitudinal axis parallel aving the summit, this y stated on account of ving the projectile at	
11	29.874		
12	29.873		
13	29.873		

	Barometer.	marks.	General remarks.
9	29.872	ed the same as in pre- ation, but while it ap- rojectile showed a re- itudinal axis parallel aving the summit, this stated on account of ing the projectile at	
5	30.023	.....
0	30.023	.....
5	30.083	erved, projectile be- summit of trajectory.	In rounds 70 to 75, inclusive, a primer was placed in the Horney firing mechanism in mortar No. 2, and a lanyard attached to the firing leaf. This lanyard was led across the pit and fastened to the south wall of same. Mortar No. 2 had an elevation of 0°. The iron doors leading to the pit were closed in order to ascertain whether shutting off the air in the gallery would make a difference to the blast effect in the pit. The lanyard was given an initial tension of about 10 pounds. The primer stem was loosened so that it had a travel of about 0.1 inch, but was not fired. Lanyard was observed during rounds 72 and 73 and was noted to vibrate with amplitude of about 6 inches.
5	30.083	bserved considerably mit. When the pro- of the piece it had a which continued ap- s of the time of flight. appeared to decrease tle was steady after ve.	
15	30.080	appeared steady, but o the summit on ac- t of same.	
15	30.080	noted in relation to as apparent in flight not be distinctly seen r velocity.	
14	30.076	.....
12	30.073	.....	<p>(Sketch showing position of lanyard, rounds 70 to 75, inclusive.)</p> <p>It is thought the difference in recoil on the two cylinders may account for the swaying of the projectile in rounds 69, 71, 73, and 75.</p>
9	30.073	.....
5	30.073	1. Lanyard vibrated	
0	30.069	0. Lanyard vibrated r did not fire.	
5	30.069	1. Lanyard vibrated did not fire.	



Barometer.	Remarks.	General remarks.
30.068	not be observed on position.	
30.091	not be observed on position. Lanyard attached and to hydrant at r did not fire.	
30.091	g round. This round creetching sound, evig.	
40.095	creetching sound same ght of projectile as for lead; after that time view,	<p>Mortars Nos. 2 and 4 have lanyard attached (elevation zero), with a washer between the button and the firing leaf so as to take up all the play between the firing leaf and the button; this remark applies to mortars Nos. 1 and 3 as well.</p>
60.095	g round, except there l.	
60.958	not be observed on upper air. Primers in fired.	
57.568	.....
58.38	ttle same. Primer in fired.	
49.9	.....	<p>Firing conducted by Lieut. W. J. Hawkins, Ordnance Department.</p>
45	.....
45	ly during first 3 or 4 projectile was lost to	

CHAS. S. SMITH,
Colonel, Ordnance Department, U. S. A.,
Commanding.

WILFORD J. HAWKINS,
Lieutenant, Ordnance Department, U. S. A.,
Assistant Proof Officer.

mortar, c

Pressure as determined
by preliminary firing.

lbs. Pound

12 28, 71

5 26, 62

+ Later
- Later

rtar, cast iron, steel hooped, model of 1886—Continued.

Pounds.	Pressure as determined by preliminary firing.	Velocity as determined by preliminary firing.	Range.	Drift.	Time of flight.		Wind.		Wind com- ponents.		Barometer.	Thermometer.	Humidity.
							Direction.	Miles per hour.	Longitudinal, miles per hour.	Lateral, miles per hour.			
28, 712	960	Yards.	°	'	Secs.	Secs.	°						
		7,680	0	57	40.8	Lost.	-21 R	13	-12.0	+ 4.5	30.088	71.00	84.00
		7,582	1	44	39.6	39.6	-21 R	12	-11.5	+ 4.0	30.059	69.00	86.40
		7,480	1	46	43.0	43.0	-21 R	12	-11.5	+ 4.0	30.059	69.00	84.40
		7,180	1	56	44.8	45.6	-21 R	15	-14.0	+ 5.5	30.073	69.00	86.00
		6,905	1	54	47.4	Lost.	-21 R	14	-13.5	+ 5.0	30.073	69.00	86.00
		5,945	2	14	49.2	49.4	-21 R	14	-13.5	+ 5.0	30.073	69.00	85.60
		6,428	2	41	51.0	51.2	-21 R	15	-14.0	+ 5.5	30.076	69.00	85.60
		6,324	1	55	48.2	48.8	-21 R	14	-13.5	+ 5.0	30.080	69.00	85.30
		6,403	2	33	48.6	48.0	-21 R	14	-13.5	+ 5.0	30.080	69.00	85.30
		7,957	2	10	40.2	40.2	-66 R	7	-2.5	+ 5.5	30.106	66.43	37.77
		7,657	2	28	43.0	43.0	-66 R	5	-2.0	+ 4.5	30.107	66.02	39.04
		7,322	2	57	46.4	46.6	-66 R	6	-2.25	+ 5.0	30.109	65.54	40.07
		6,818	3	48	48.6	48.6	-66 R	6	-2.25	+ 5.0	30.111	56.02	41.15
		6,310	4	43	50.6	50.4	-66 R	6	-2.25	+ 5.0	30.113	64.56	42.11
26, 625	1,060	6,620	3	48	47.8	48.2	-51 R	5	-2.25	+ 4.6	30.117	63.68	43.96
		6,464	4	29	48.8	48.8	-51 R	6	-4.5	+ 4.25	30.119	63.19	44.85
		9,058	1	52	Lost.	46.0	-66 R	14	-5.0	+ 13.0	29.957	74.00	91.00
		9,038	2	1	Lost.	45.0	-66 R	15	-5.1	+ 13.5	29.958	73.00	92.00
		8,750	1	28	52.8	49.8	-66 R	20	-7.0	+ 19.0	29.958	73.00	92.00
		8,360	2	24	49.2	50.8	-21 R	8	-7.7	+ 3.0	29.958	73.00	94.00
		7,805	2	18	50.8	52.6	-21 R	10	-9.2	+ 4.0	29.958	73.00	95.00
		7,334	3	33	52.8	55.0	-21 R	10	-9.2	+ 4.0	29.958	73.00	95.00
		6,970	4	40	54.4	55.4	-21 R	12	-11.5	+ 4.1	30.096	72.00	82.00
		6,670	4	50	56.6	57.4	-21 R	12	-11.5	+ 4.1	30.095	72.00	82.00
		6,470	4	47	57.0	58.0	-21 R	14	-13.0	+ 5.1	30.091	71.00	85.00
		6,475	5	9	56.8	56.2	-21 R	14	-13.0	+ 5.1	30.091	71.00	85.00
		9,319	2	41	43.4	43.6	+24 R	10	+ 9.6	+ 4.0	30.098	75.71	42.48
		9,158	2	43	46.4	Lost.	+24 R	9	+ 8.8	+ 3.5	30.097	76.81	39.25
		8,737	3	24	49.4	49.2	+24 R	10	+ 9.6	+ 4.0	30.097	77.78	36.51
8,405	3	52	51.8	52.8	+24 R	12	+ 8.0	+ 3.0	30.124	73.48	47.42		
7,499	5	6	55.8	55.8	+24 R	9	+ 8.8	+ 3.5	30.130	72.00	49.83		
		6,795	6	47	59.8	57.8	+24 R	5	+ 5.0	+ 2.1	30.138	70.49	53.34

- Lateral components tend to deflect the projectiles to the left.

- Lateral components tend to deflect the projectiles to the right.

PLATE I

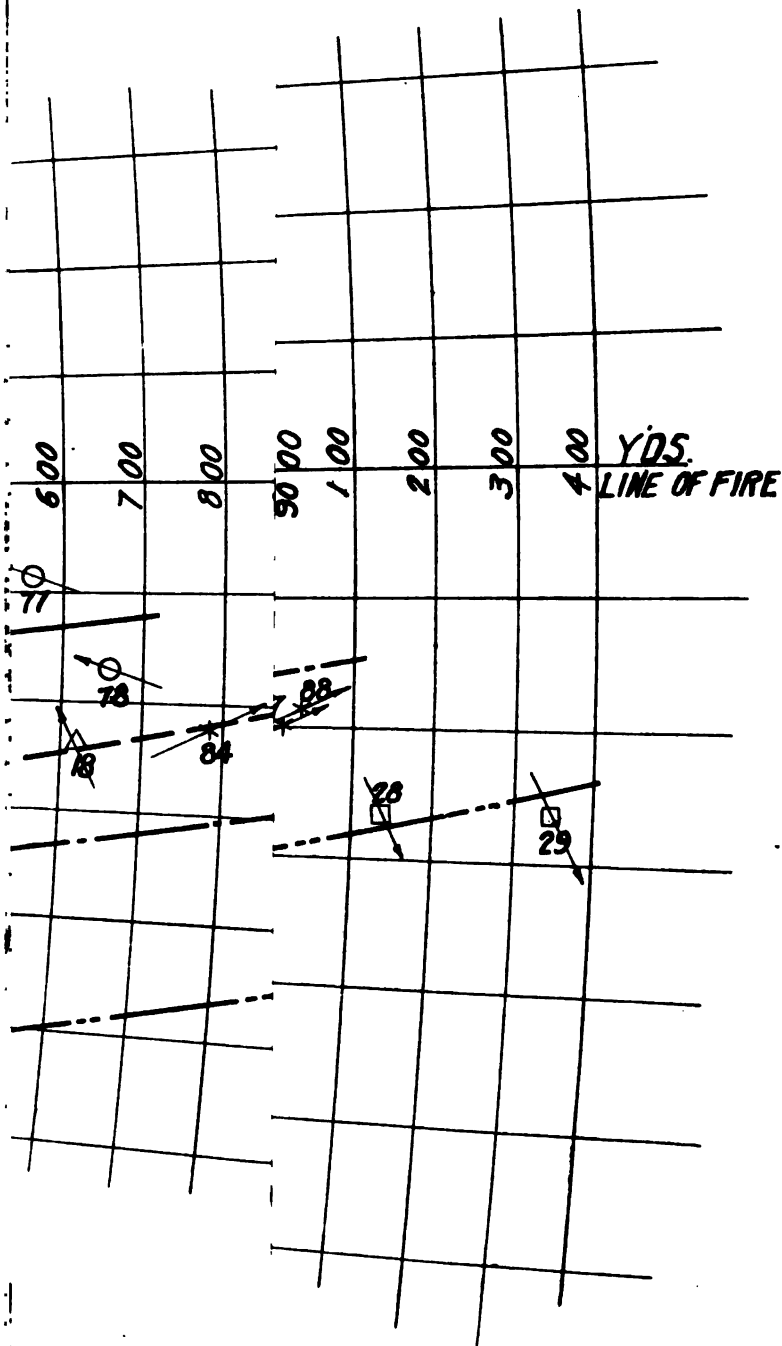


PLATE 2.

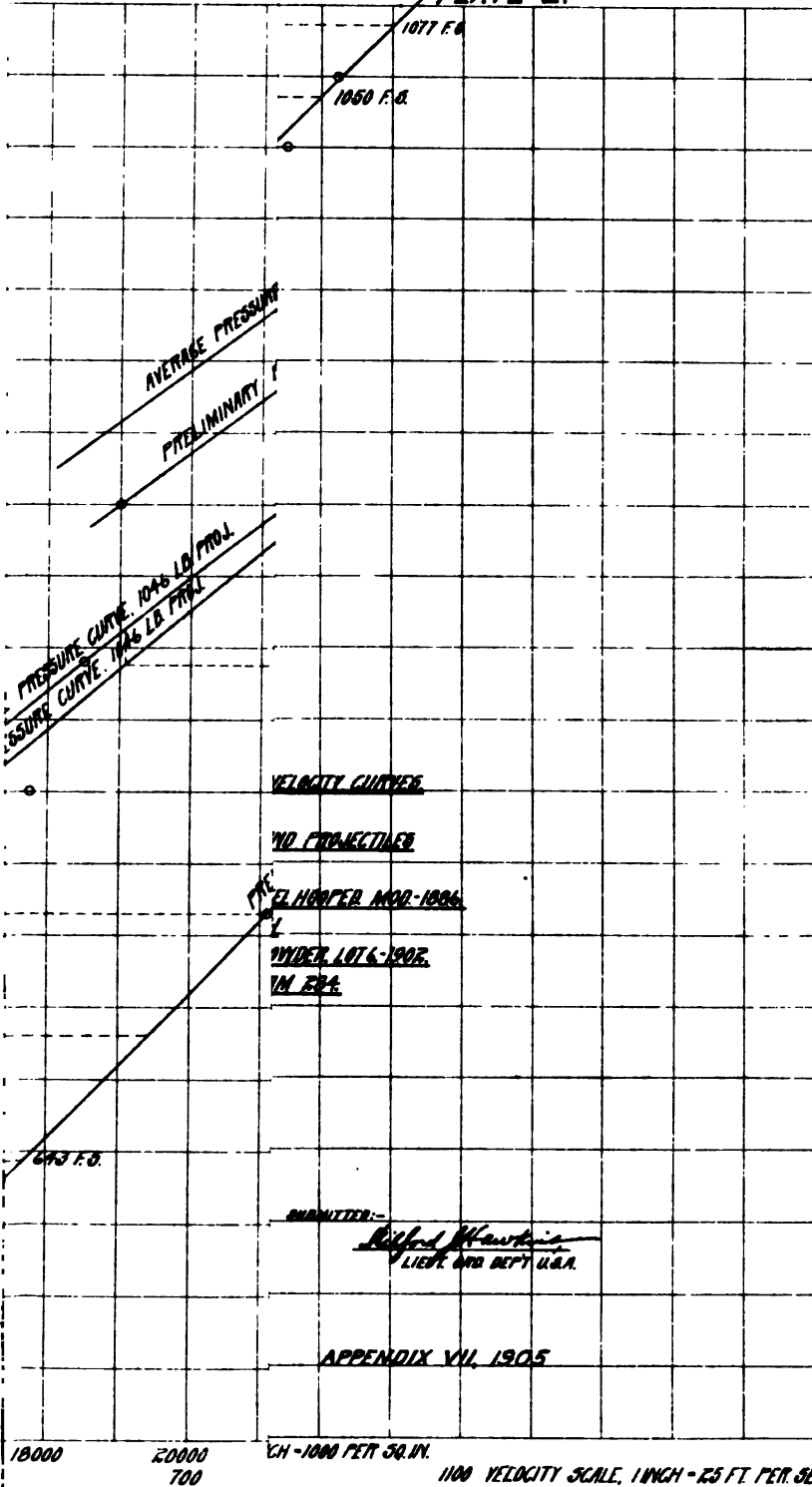


PLATE 3.

1077 F.S.

1046 F.S.

AVERAGE PRESSURE

PRELIMINARY

2 LB PROJ

1046 LB PROJ

637 F.S.

VELOCITY CURVES

FOR PROJECTILES

CAL. HOOTED. MOD-1896

DATA 1876-1902

M. B.B.

SUBMITTED:-

Richard S. Hartman

LIEUT. U.S. ARTY. U.S.A.

APPENDIX VII, 1905.

Hilfred J. Hartine
LIEUT. ORG DEPT USA

APPENDIX VN, 1905.

18000

20000
700

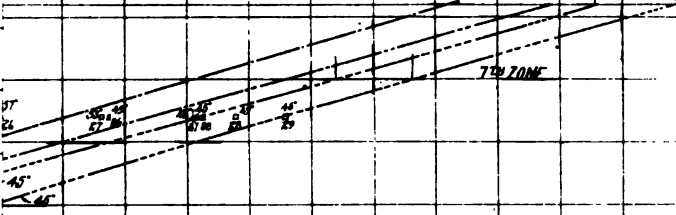
• 1000 LBS PER 30 IN

1100 VELOCITY SCALE, 1 INCH = 25 FT. PER SEC.

H Doc 2459 1

PLATE 4.

PRESSURE 29400.



W. H. H. H.

APPENDIX VII, 1905

2800

900 8600 8800 9000 9200 9400 9600 9800 10000 10200 10400

H Doc 344, 1905

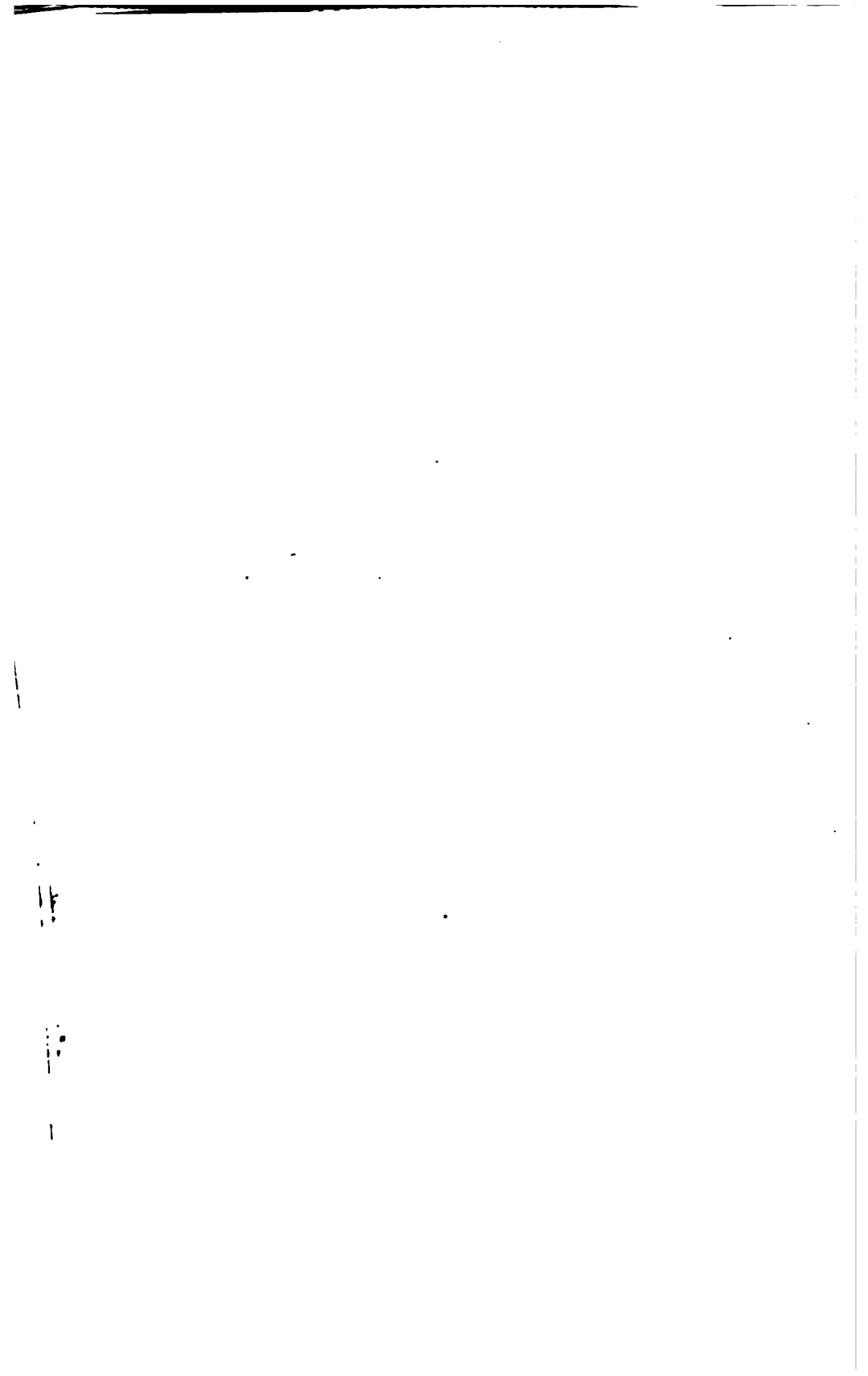
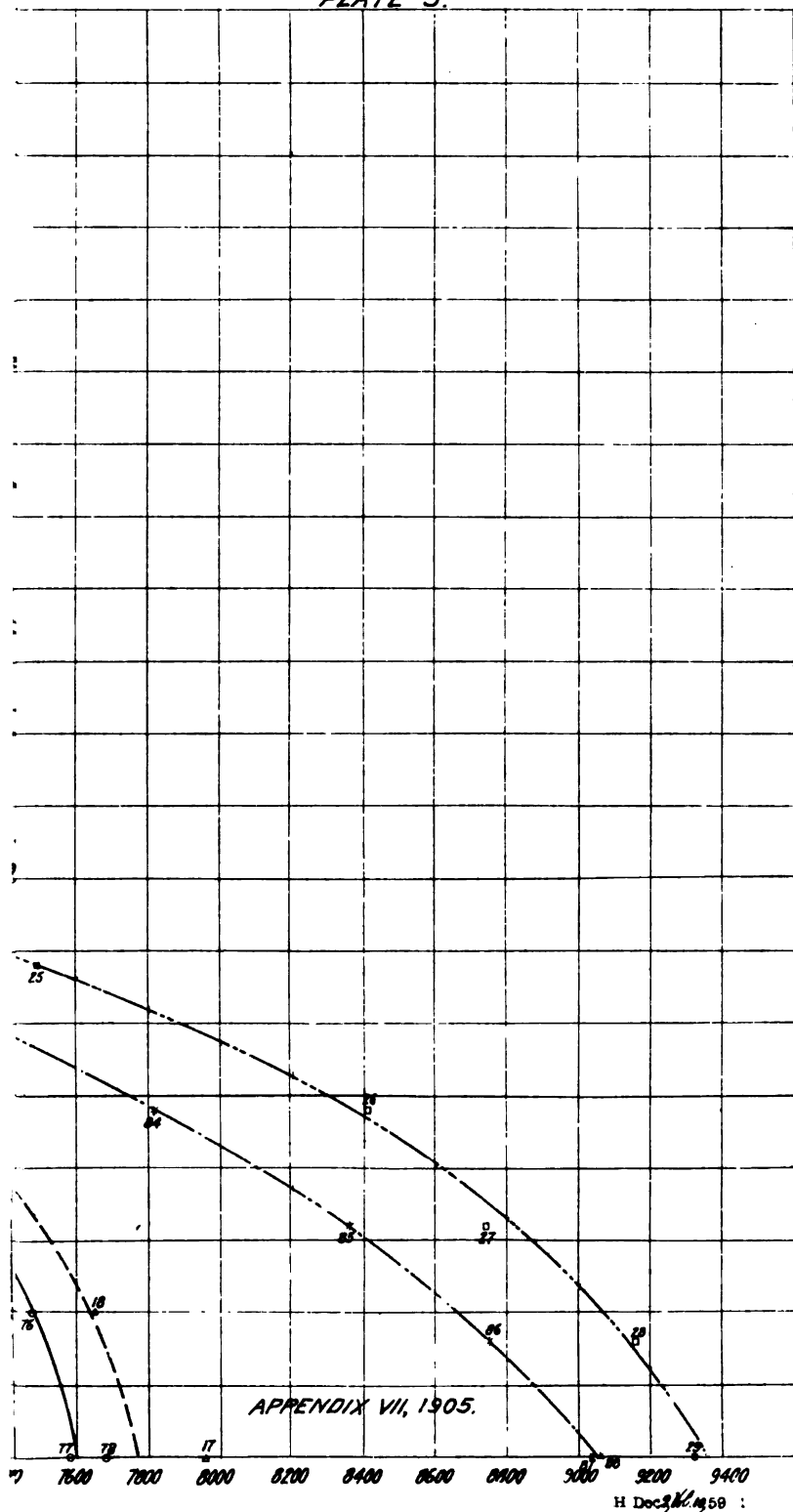
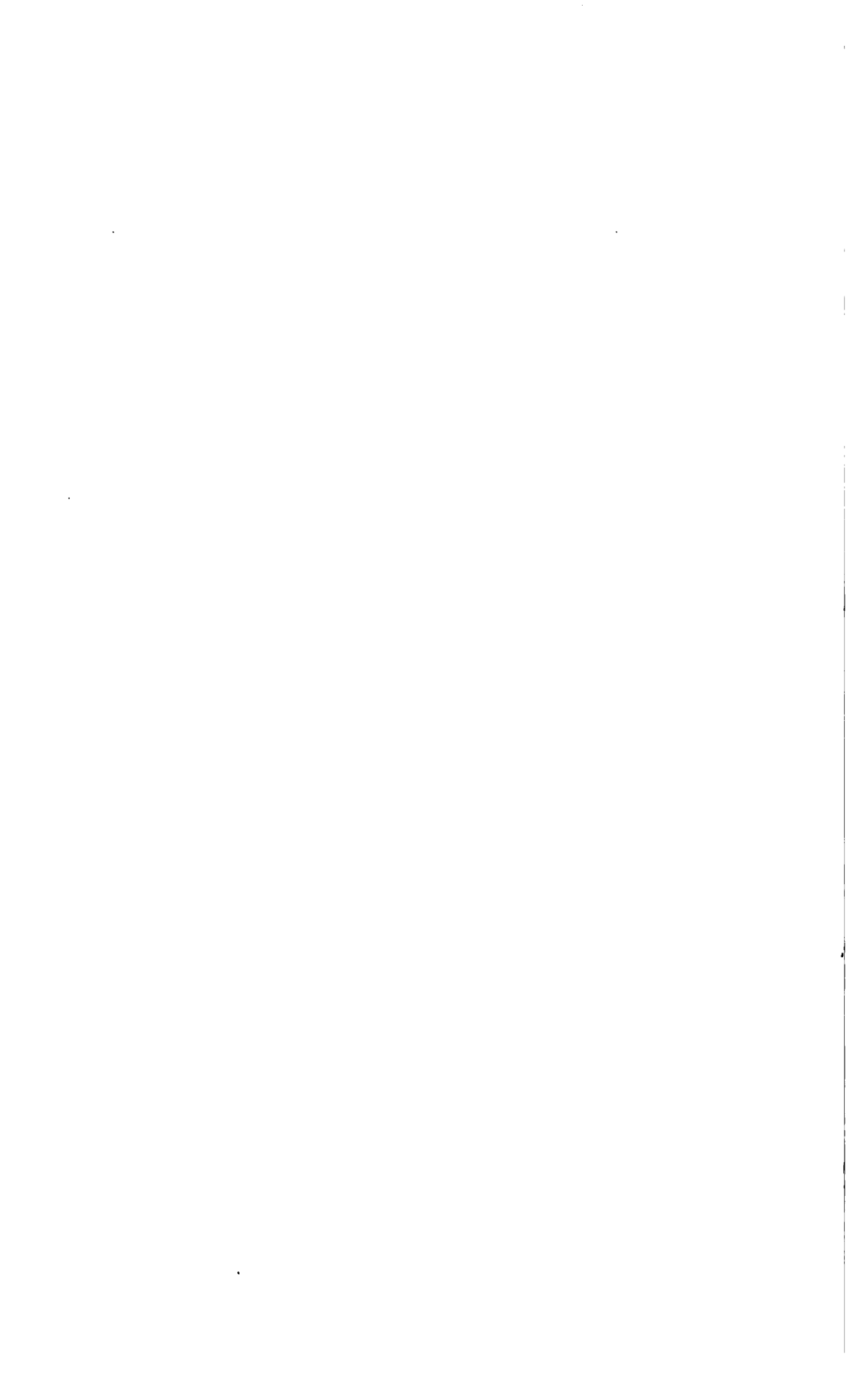


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